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1914-1915

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EIGHTH ANNUAL REPORT

OF THE

STATE ENTOMOLOGIST

OF INDIANA

95

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C. H. BALDWIN

1914-1915

FORT WAYNE
Fort Wayne Printing Co., Contractors for State Printing and Binding
1916

THE STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
February 16, 1916.

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
Indianapolis, February 16, 1916.

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

DALE J. CRITTENBERGER,
Auditor of State.

FEBRUARY 16, 1916.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

B. B. JOHNSON,
Secretary to the Governor.

Filed in the office of the Secretary of State of the State of Indiana, February 16, 1916.

HOMER L. COOK,
Secretary of State.

Received the within report and delivered to the printer February 16· 1916.

ED. D. DONNELL,
Clerk Printing Board.

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LETTER OF TRANSMITTAL.

INDIANAPOLIS, Indiana, October 30, 1915.

HONORABLE SAMUEL M. RALSTON, *Governor of Indiana:*

It is with pleasure that I submit, herewith, the manuscript for the Eighth Annual Report of the State Entomologist.

The report deals with the various phases of our work and it is the plan to have separates printed in order that the greatest economy and efficiency may be practiced in the distribution of the literature among the different industries affected by our work.

The demand for popularly written literature dealing with insects and plant diseases destructive to tree and bush fruits and truck crops is so great that it seems essential that a reprint be made of Bulletin No. 3 of this office. Manuscript for a revised reprint of this bulletin is consequently included herewith.

The various illustrations are considered essential for a proper understanding of the text.

Very respectfully,

C. H. BALDWIN,
State Entomologist.

FINANCIAL STATEMENT OF STATE ENTOMOLOGIST.

For the Fiscal Year October 1st, 1914, to September 30th, 1915.

Appropriation		$15,000.00
Salaries—		
C. H. Baldwin, State Entomologist	$2,500.00	
Clerks and deputies	7,758.00	
Miscellaneous, Office and Laboratory Expenses	985.37	
Freight and Express	120.68	
Telephone and Telegraph	147.73	
Postage	685.00	
Traveling Expenses	2,462.05	
Total Expenditures	$14,658.83	
Credit, returned to State	341.17	
	$15,000.00	$15,000.00

An itemized account of the above expenditures is on file with the Auditor of State.

License Fund.—Fees received for licenses issued to Nurserymen, Dealers and Agents engaged in selling Nursery Stock:

Receipts		$624.00
Expenditures	$240.00	
Balance on hand	384.00	
	$624.00	$624.00

INDIANA NURSERYMEN.

Name.	Address.	Kind of Certificate Issued.
A		
Abraham Bros	Martinsville, Ind	General nursery stock.
Allen, Chas. B	West Baden, Ind	Small fruit plants.
Allison Bros. Fruit Farm	Columbus, Ind	Small fruit plants.
Alstott, J. W	Corydon, Ind	General nursery stock.
Arnold, Glen	Danville, Ind	General nursery stock.
Atkinson, Roy	Fowler, Ind	General nursery stock.
Ault, Henry A	Columbus, Ind	General nursery stock.
B		
Beck, E. H	Michigan City, Ind	Small fruit plants.
Bennett, A. S	Lafayette, Ind	General nursery stock.
Bennett, O. W	Doans, Ind	General nursery stock.
Bierly, Otis R	Borden, Ind	Strawberry plants.
Bennett, Mrs. Mary and Sons	Grandview, Ind	Small fruit plants.
Billingsly, S	Greenwood, Ind	General nursery stock.
Blankenbaker, E. E	Borden, Ind	Blackberry and strawberry.
Bonames, G. W	Milltown, Ind	General nursery stock.
Brandywine Nurseries	Greenfield, Ind	General nursery stock.
Bremen Nursery Co	Bremen, Ind	General nursery stock.
Brenneman, Moody	Berne, Ind	General nursery stock.
Burkhart's Nursery	Indianapolis, Ind	General nursery stock.
Burkhart, H. A	Indianapolis, Ind	Shade trees and ornamentals.
Bucksin Nursery	Elberfield, Ind	General nursery stock.
Burns City Nursery	Burns City, Ind	General nursery stock.
C		
Cain, W. D	Shelburn, Ind	Small fruit plants.
Callahan, P. H	Pekin, Ind	Blackberry and strawberry.
Cathcart, A. Y	Bristol, Ind	General nursery stock.
Centerville Nurseries	Centerville, Ind	General nursery stock.
Childers, G. W	Valeene, Ind	Small fruit plants.
Coats, John	Borden, Ind	Small fruit plants.
Collins, Lamar	Underwood, Ind	General nursery stock.
Cunningham Nursery Co	Seymour, Ind	General nursery stock.
Cutler, D. L	Warsaw, Ind	General nursery stock.
D		
Davis, George	Brazil, Ind	Small fruit plants.
Doans, J. L	Westfield, Ind	Ornamental shrubs.
E		
Erwin, T. J	Mt. Vernon, Ind	Chestnut and pecan trees.
Everetts, J. W	Hamilton, Ind	Catalpa trees.

INDIANA NURSERYMEN—Continued.

Name.	Address.	Kind of Certificate Issued.
F		
Favorite Nursery	Granger, Ind	General nursery stock.
Fairview Gardens	Elnora, Ind	Catalpa trees.
Fairview Nurseries	Koleen, Ind	General nursery stock.
Flarg, A. E. & Son	Logansport, Ind	Small fruit plants.
Fonner, W. A	Decatur, Ind	Strawberry plants.
Fullhart, Charles	Muncie, Ind	General nursery stock.
Furnas, T. Chalmers	Mooresville, Ind	Small fruit plants.
G		
Gaar, M. H	Cambridge City, Ind	General nursery stock.
Gesier, H. L	Seymour, Ind	General nursery stock.
Goss, D. L	Borden, Ind	Small fruit plants.
Goehler, Albert	Urbana, Ind	General nursery stock.
Graham, Chas. F	Jeffersonville, Ind	General nursery stock.
Gray's nursery	Salem, Ind	General nursery stock.
H		
Halbrook, Wm	Evansville, Ind	General nursery stock.
Haas Home Nursery	Terre Haute, Ind	General nursery stock.
Harrington, F. A	Gilead, Ind	Strawberry plants.
Henby & Sons, J. K	Greenfield, Ind	General nursery stock.
Halleck, Chas	Fair Oaks, Ind	General nursery stock.
Hobbs & Sons, C. M	Bridgeport, Ind	General nursery stock.
Hobbs, Franklin	Osceola, Ind	Barberry plants.
Home Nursery	Hatfield, Ind	General nursery stock.
Horton, Eugene	Wagoner, Ind	General nursery stock.
Hill, E. G. & Co	Richmond, Ind	Rose stock.
Howe & Stanfield	Scipio, Ind	General nursery stock
I		
Indiana Nut Nursery	Rockport, Ind	Pecan and walnut.
Indianapolis Flower and Plant Company	Indianapolis, Ind	Ornamental shrubs.
J		
Jackman, H. E	Waterloo, Ind	General nursery stock.
Jackson, Hamilton	Borden, Ind	Small fruit plants.
Jarrett, J. A	Keystone, Ind	Shade trees.
K		
Kankakee Valley Nursery	Walkerton, Ind	General nursery stock.
Kemp, Eben	Martinsville, Ind	Peach trees.
Kellum, R. S	Clay City, Ind	Strawberry plants.
Kreider Nurseries, The	Middlebury, Ind	General nursery stock.
L		
LaHayne, Wm	Chesterton, Ind	General nursery stock.
Lafayette Nursery	Lafayette, Ind	General nursery stock.
Littlepage, T. P	Boonville, Ind	Nut trees.
Long, T. A	Westfield, Ind	General nursery stock.
Lykens, Henry	Elnora, Ind	Small fruit plants.

INDIANA NURSERYMEN—Continued.

Name.	Address.	Kind of Certificate Issued.
M		
M. M. Nursery, The	Columbia City, Ind	General nursery stock.
Maplewood Floral Co	South Bend, Ind	General nursery stock.
Martindale, Moses	Doans, Ind	General nursery stock.
Mays, W. H	Goshen, Ind	General nursery stock.
Meeker & Rockwell	Crown Point, Ind	General nursery stock.
Merrill, H. R	Brownstown, Ind	General nursery stock.
Moyer, G. N	Laketon, Ind	General nursery stock.
Moffitt, Frank	Carmel, Indiana	Small fruit plants.
Murray, A. M	Goshen, Ind	General nursery stock.
Mason, B. F	Martinsville	General nursery stock.
Mc		
McClaran, Chas. & Son	Ramsey, Ind	General nursery stock.
McCoy, R. L	Lake, Ind	General nursery stock.
McCormick, Chas	Burns City, Ind	General nursery stock.
McElderry, W. E	Princeton, Ind	General nursery stock.
N		
Neet, Geo. W	Valparaiso, Ind	Apple and strawberry.
Noble, J. M	Sellersburg, Ind	Small fruit plants.
National Fruit and Plant Farm	Gilead, Indiana	Strawberry plants.
New Albany Nursery, The	New Albany, Ind	Peach and shade trees.
O		
Ooley, Burt	Borden, Ind	Small fruit plants.
Osborne, James T	Burns City, Ind	Small fruit plants.
P		
Palmer, Fred L	Indianapolis, Ind	General nursery stock.
Phillips, Jos. A	Bloomfield, Ind	General nursery stock.
Plotner, S. C	Mishawaka, Ind	Strawberry plants.
Polhamus, A. Z	Fort Wayne, Ind	Small fruit plants.
Portland Nursery	Portland Ind	General nursery stock.
Prebla, A. C	Marion, Ind	General nursery stock.
Q		
Quillen, Chas	Mooresville, Ind	Small fruit plants.
R		
Ragle, Amos	Elnora, Ind	General nursery stock.
Rathburn, L. G	Orland, Ind	General nursery stock.
Reed, W. H., Jr	Hanover, Ind	Small fruit plants.
Reed, W. C	Vincennes, Ind	General nursery stock.
Richland Nurseries	Bloomfield, Ind	General nursery stock.
Ridgefarm Nursery	Bloomfield, Ind	General nursery stock.
Roerk, F. M	Borden, Ind	Blackberry plants.
Roerk, T. J	Borden, Ind	Small fruit plants.
Rego Nursery, The	Paoli, Ind	Small fruit plants.
S		
Shields, Thomas	Anderson, Ind	General nursery stock.
Shields Bros. Nursery	Charlottsville, Ind	General nursery stock.

INDIANA NURSERYMEN—Continued.

Name.	Address.	Kind of Certificate Issued.
Smith, J. E.	Muncie, Ind.	General nursery stock.
Simpson, H. M. & Sons.	Vincennes, Ind.	General nursery stock.
Shoemaker, W. A.	Spencer, Ind.	Peach trees and small fruit.
Stemple, Chas. K.	Richmond, Ind.	General nursery stock.
Strite, Charles	Butler, Ind.	Small fruit plants.
Sturm, Chas. C.	Elizabeth, Ind.	General nursery stock.
Stuart & Haugh	Anderson, Ind.	General nursery stock.
Sunshine Nurseries	Corydon, Ind.	General nursery stock.
T		
Tate, Jacob	Mexico, Ind.	Strawberry plants.
Thornburgh, G. H.	Evansville, Ind.	Shade trees and ornamental shrub.
Todd Fruit Farm	Bedford, Ind.	Small fruit plants.
Terrill & Maheuron	Pekin, Ind.	Small fruit plants.
W		
Walts, W. C.	Pennville, Ind.	Strawberry plants.
Weber, C. H.	Greenfield, Ind.	General nursery stock.
Whicker, Otto	Amo, Ind.	General nursery stock.
Wheaton, Everett	Mt. Liberty, Ind.	Peach trees.
White, Harry	North Manchester, Ind.	Greenhouse stock.
Winchell, G. W.	Tobinsport, Ind.	General nursery stock.
Wilson, Elias	Carmel, Ind.	Small fruit plants.
Wiltshire, L. C.	Winona Lake, Ind.	Strawberry plants.
Walker, The F. Co.	New Albany, Ind.	General nursery stock.

It is the policy of this office to hold in trust the list of representatives of the various nurseries having agents in this State for the reason that the nurserymen who have taken great care in selecting men to represent them in the various parts of the State have a right to consider their list of representatives as confidential.

The list of dealers, however, who are not working under instructions from any particular principal, but are licensed in accordance with the definition of the term "dealer" as given in the license law, is published herewith.

DEALERS WHO ARE NOT ENGAGED IN THE GROWING OF NURSERY STOCK.

Name.	*Address.*
A	
Aebersold, A. F.	New Albany, Ind.
Ayres & Co., L. S.	Indianapolis, Ind.
B	
Bargain Store, The	Tipton, Ind.
Banta, A. A.	Indianapolis, Ind.
Barnhart, Wm.	Indianapolis, Ind.
Bash Seed Store	Indianapolis, Ind.
Beumer, H. E.	Holland, Ind.
Blount, J. W.	Blountville, Ind.
Brower, D. W.	Indianapolis, Ind.
Byen, F. A.	New Albany, Ind.
C	
Clark, J. W.	Summitville, Ind.
Clemets, H. B.	Indianapolis, Ind.
Conway, Peter	Borden, Ind.
Crider, O. B.	Greenfield, Ind.
Crider, C. A.	Indianapolis, Ind.
D	
Derbyshire, D. D.	Muncie, Ind.
Dietz, John	Indianapolis, Ind.
Dunn, Cooper M.	Indianapolis, Ind.
F	
Fine, A. J.	Bedford, Ind.
Forsha, Humphrey	Indianapolis, Ind.
Forbes Seed Store	Plymouth, Ind.
Fagan Seed Store	Indianapolis, Ind.
Felt, Frank V.	Greenfield, Ind.
Ford, Frank	Greensburg, Ind.
Fuschinsky, Alex	Indianapolis, Ind.
G	
Gustin, E. R.	Peru, Ind.
Gary, Robert G.	Gas City, Ind.
Gaar, Wm. H.	E.Germantown, Ind.
Guston, Web.	Anderson, Ind.

Name.	*Address.*
H	
Hurst, C. L.	Marion, Ind.
Heindselman, J. R.	Carlisle, Ind.
Heller Brothers Co.	New Castle, Ind.
Hertlein, J. P. A.	New Albany, Ind.
Hinkle, Hugh	Bloomington, Ind.
Hits, L. E.	Madison, Ind.
Hudson, J. F.	Portland, Ind.
Hudson, L. W.	Portland, Ind.
Hults, Jos. G.	Terre Haute, Ind.
K	
Kester, H. L.	Middletown, Ind.
King, Fred A.	Winona Lake, Ind.
Knipe, Tom	Kokomo, Ind.
Klus & Son	Anderson, Ind.
Mc	
McFeran, Hiram	Columbus, Ind.
McSwane, Isaac E.	Lynnville, Ind.
M	
Moore, Ray H.	Greenfield, Ind.
Mohler, D. M.	Martinsville, Ind.
Marts, S. J.	Indianapolis, Ind.
Mettler, Mathies	Fort Wayne, Ind.
O	
Osborne, Miss Grace	Indianapolis, Ind.
P	
Peters, H. O.	Shirley, Ind.
Palmer, F. L.	Indianapolis, Ind.
Reupke, Albert H.	Terre Haute, Ind.
Rogers, Hugh & Son	Knox, Ind.
Rupp, Fred	Lawrenceburg, Ind.
Rutherford, I. K.	Bluffton, Ind.
S	
Scultz, Peter	Hammond, Ind.
St. Joseph Valley Nursery Co.	Elkhart, Ind.
Sumner, A. E.	Garrett, Ind.
Schaub, Theophile	Fort Wayne, Ind.
Shakes, Chas.	Indianapolis, Ind.
Shinn, A. B.	Hammond, Ind.
Silver, Milo	Columbus, Ind.
Slavens, A. J.	Bellmore, Ind.
Smith, A. D.	Indianapolis, Ind.
Stacy, W. E.	Lyons, Ind.
State Forestry Co.	Indianapolis, Ind.
Stout, Floyd H.	Monrovia, Ind.
T	
Teeters, Russell C.	Portland, Ind.
Telscher, C. W.	Crown Point, Ind.
V	
Van Fleet, Ed.	Garrett, Ind.
Vannice, J. O.	Indianapolis, Ind.
Von Carlezon, Geo.	Richmond, Ind.

Name	*Address*
W	
Walker Co., F., The	New Albany, Ind.
Walton, W. O.	Rushville, Ind.
Weller, J. E.	Portland, Ind.
Wiegand, A. and Sons	Indianapolis, Ind.
Wilson, J. A.	Greenfield, Ind.
Wilson, J. N.	Plymouth, Ind.
Woods, A. E.	Greenfield, Ind.

INSECTS OF THE YEAR, 1914-1915.

SAN JOSE SCALE.

Aspidiotus perniciosus Comst.

At the time of the enactment of the present nursery and orchard inspection laws of Indiana, about nine years ago, it was supposed that this insect existed in only a few localities and these laws called for a detailed report concerning the distribution of the insect in the State. It was soon learned that San Jose scale was established in more territory in Indiana than was at that time supposed. It subsequently spread to the various points in the State where it was at that time not established. This resulted in the pest pretty thoroughly covering the State. There are, however, a few localities in the southern part of the State where the scale has not yet found its way into the orchards, and it is possible to find large areas comprising one or more townships, where San Jose scale has not gotten a foothold. Its worst damage is during the first few years of its establishment in a new territory. The good results in subduing this pest, by natural enemies, has been very marked in certain parts of the United States, noticeably in Pennsylvania. Dr. H. A. Surface, Economic Zoologist of Pennsylvania, has brought to the attention of the public the fact that various parasitic enemies have been at work on the scale in that State to such an extent that the scale has been eradicated in large areas, comprising entire counties. This office has made an effort to introduce some of these parasites into this State, but at this time no results have been obtained. It is, however, a line of work which should be continued, as we have positive evidence that one or more of the San Jose scale parasites are at work in Indiana.

The writer had his attention called to an orchard just south of Indianapolis last June, where it was reported that the trees which had been severely infested with San Jose scale appeared to be taking on new life. Investigation showed very good work being done by certain parasites, and it was estimated that at least

75 per cent. of the scale insects on the trees had been killed by one or more of these natural enemies. It is quite probable that these natural enemies will play an important part in the subjugation of scale in this State. It is urged that the ordinary spraying operations, which have been so successful in cleaning up this pest, be not discontinued with the idea that the parasites will take care of the situation. The work of these natural enemies is entirely too uncertain, from a fruit grower's point of view.

The following statement is quoted from Dr. H. A. Surface, showing the different species of scale parasites which work in the State of Pennsylvania:

"These minute specimens include just one dozen different species, two of which are probably new to science, and ten of which have been identified as named species, some of which are common and others very rare. As there are no common names for the different species or kinds of these parasites, they must be known by their scientific names, which are as follows:

Aphelinus fuscipennis, bred from oyster-shell and San Jose scale.

Prospaltella aurantii, bred from San Jose and oyster-shell scale.

Prospaltella perniciosi, male and female, bred from oyster-shell and San Jose scale.

Encyrtine, with eggs, bred from San Jose scale.
Encyritine, bred from Rose and San Jose scale.
Anagrus spiritus, bred from San Jose scale.
Sipniphora nigra, bred from San Jose scale.
Perissopteris mexicanus, bred from San Jose and oyster-shell scale.
Aspidiophagus citrinus, bred from rose scale.
Arrhenophagus chionaspidis, bred from rose scale.
Ablerus clisiocampae, bred from San Jose scale.

Unnamed species, with eggs, bred from San Jose and oyster-shell scale."

In addition to the parasites discussed above, there are ten or twelve specimens of ladybird beetles which are predaceous on San Jose scale. The ladybird beetles as a group are very important, but chief among these as scale feeders may be mentioned the twice-stabbed ladybird beetle, *Chilocoruruss bivulne*. Another very important ladybird beetle is the tiny black species, *Smilia misella*. Both adults and larvae of these latter species feed greedily upon San Jose scale. The fact that this pest is so successfully held in check in its native home, China, by a ladybird beetle, *Chilocorus similis*, has lead entomological workers to an effort to establish this valuable scale feeder in the United States. For one cause or another these efforts have to this time been fruitless. In view of the valuable work done by parasitic and predaceous enemies and on account of the very successful control measures by spraying, it is very encouraging at this time to know that San Jose scale is not the serious pest that it was predicted to become at the time it first became established in various sections of our country. The pest has been termed by some as a blessing in disguise, for the reason that it has made it necessary for many to resort to spraying operations in order that the life of their trees may be saved, and the growers have incidentally controlled many other insects of less importance as well as fungous troubles, and as a result have produced a much better grade of fruit than would have otherwise been grown.

The spraying control measures may be briefly described by saying that thorough spraying with lime sulphur solution, properly made and properly diluted, or with miscible oils or with oil emulsions is necessary. Several of these materials may be made at home, but it has been our experience and the experience of growers in general that with the possible exception of lime sulphur solution it is not practical to attempt the home manufacture of these spraying materials. Lime sulphur solution has been more generally used in this State than any of the others, and it is still held to be the most practical for scale spraying. Miscible oil is particularly adapted to city and town use where the trees to be sprayed are located near painted buildings since this material does not act upon the lead paints as does the sulphur mixtures. It is important that the quantity of the solution to be used be known and dilution be made accordingly. In a general way the recommendations of the manufacturers may safely be followed.

PUTNAM SCALE.

Aspidiotus ancylus PUTNAM.

This is a native insect which thrives on a large list of host plants. Its appearance is somewhat similar to that of the San Jose and Cherry scale and is consequently often confused with those species. Putnam may be distinguished, however, from

San Jose, by an orange-colored exuvium which, instead of being located at the center of the scale covering is more to one side. The life history of the Putnam scale is quite different from that of San Jose scale, the chief points of difference being as follows:

Putnam scale produces one brood of young annually, while San Jose produces from four to five broods. Putnam scale lays eggs while San Jose gives birth to living young. The winter is passed by this species as nearly full-grown insects, while those of the San Jose scale which successfully pass the winter are about half grown.

The fact that it is a native insect which causes it to be preyed upon by various native parasites, and the fact that it has but one brood a year, makes this species much less destructive than the San Jose scale.

The remedial measures which have so successfully been used against San Jose scale will effectively hold this insect in check.

OYSTER-SHELL SCALE.

Lepidosaphes ulmi LINN.

This insect attacks a great number of hosts and during the past year our attention has been called to extremely severe infestations on lilac, willow, mountain ash and poplar. It appears that these are the susceptible hosts in this State. It has been only in exceptional cases where we have found oyster-shell scale to infest fruit trees sufficient to justify particular measures against it. It is not at all uncommon to find a slight infestation on apple or pear, but a few instances have been noted where a very severe infestation occurred on a few branches of apple and pear trees. It is obvious, that in cases such as this, it may be advisable to remove the severely infested branches. In those orchards where the San Jose scale exists, and spraying is carried on against that species, oyster-shell is successfully held in check by this treatment. We have been unable to determine that there is more than one brood of oyster-shell per year in Indiana. That is hatched about the middle of May, and on host plants which are particularly susceptible and severely infested. It would be advisable to apply remedial measures in the form of a spray soon after the young have hatched. It is at this stage of their development that they are most vulnerable. The application of soap and oil emulsion at a strength which will not injure the foliage will very effectively clean up the infestation if applied during the first or second week in June. On trees which are being treated for San Jose scale there is little chance of oyster-shell getting a start.

SCURFY SCALE.

Chionaspis furfura FITCH.

This scale insect is a native American species. Our records indicate that it is occasionally quite serious on apple and pear. It is only in rare cases, however, that it becomes of great economic importance. A number of cases were brought to our attention in the city of Indianapolis, where the insect was very bad on pear trees, and when the male scales, which are pure white in color and much smaller than the grayish females, began to show up, these white male scales often attracted the attention of the property owner and consequently our attention was brought to the case.

The female scale lays her eggs about the middle of September, and these pass the winter underneath the old scale covering. The females die and wither up beneath the scale covering. There is but one brood per year. The treatment used against San Jose scale will effectively keep this insect from becoming serious as the scale which covers the eggs during winter will to a great extent be destroyed, thus exposing the eggs to the elements and in that way preventing their development.

COTTONY MAPLE SCALE.

Pulvinaria vitis LINN.

Cottony maple scale, which five years ago became so destructive in Indiana has, presumably through the work of parasites, for several years been much less in evidence. The past season, however, shows that this scale insect, which has caused the death of so many maple and linden trees in our cities, is likely again to become a very serious shade tree pest. The winter application of lime sulphur or some miscible oil is perhaps the most practical control measure. In cases, however, where the infestation shows severely in the spring where the winter application was not given, it is important that a summer treatment should be applied very soon after the young insects have hatched.

WOOLLY MAPLE-LEAF SCALE.

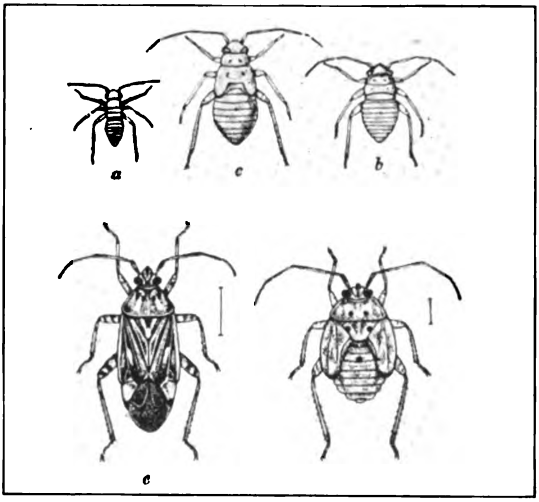
Phenacoccus acericola WALSH & RILEY.

This species has been observed to be a serious shade tree pest in several cities and towns in the northern part of the State, and is often confused by property owners with the cottony maple scale.

SEVENTEEN YEAR LOCUST.

Cicada septendecim LINN.

One of the twenty-two more or less distinct broods of the Cicada appeared in southern and central Indiana during the past summer, but this brood is relatively unimportant and no appreciable damage was done by it. The general alarm, however, was evident upon the appearance of this small brood. The main brood for Indiana is due to emerge from the ground in 1919.



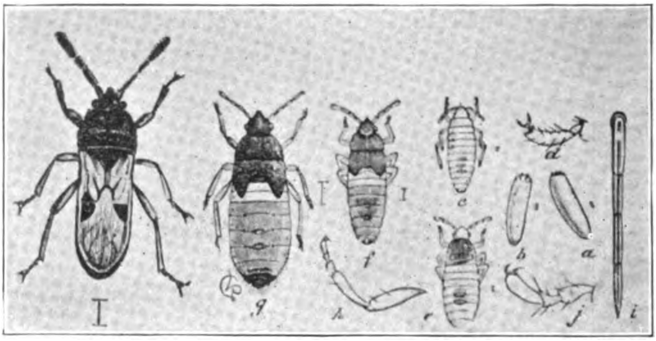
TARNISHED PLANT-BUG.
Life History.
(After Forbes & Chittenden, U. S. D. A.).

TARNISHED PLANT BUG.

Lygus pratensis LINN.

This insect is very generally distributed throughout the country, and no part of Indiana is free from the tarnished plant bug. It is such a general feeder on both cultivated and wild plants that it would not be expected to be found confined to any particular section. Many instances of injury have been recorded during the past season, but the "Stop back" trouble reported from various parts of he country in peach nursery stock has not been observed on Indiana nurseries.

The feeding is confined almost entirely to the tender parts of the plant and the results of the feeding seems to be more than mechanical as the surrounding tissues are killed, indicating some poisonous effect produced by the feeding. Like other true bugs, the puncture is made into the tissues from which the juice of the plant is sucked out. Strawberry growers have suffered considerably from the effects of this insect. The control is a difficult problem, in view of the great number of plants on which the tarnished plant bug feeds, and also on account of the bugs being so active, thus making it difficult to hit them directly with the spray solution. A contact insecticide is, of course, necessary as their feeding habits make it impossible to poison them with an arsenical as can be successfully done in cases such as beetles, larvae, etc., which chew the surface or tissue of the plant.



CHINCH-BUG.
Life History.
(After Riley, U. S. D. A.).

CHINCH-BUG.

Blissus leucopterus SAY.

The condition of this pest in Indiana during the summer of 1914 was very similar to that of 1913.

It is quite probable that with a favorable season for the development of this pest, that it will cause considerable damage in those localities where it has been giving more or less trouble during the past two seasons. We have not learned of any neighborhood where thorough winter control measures have been tried, and it seems that the farmers will neglect this important control work until the pest becomes so serious that their entire corn crop is threatened.

The control consisting of a dusty furrow and, during rainy weather, the use of the oiled line barrier has been generally practised.

THE FALSE APPLE RED BUG.

Lygidea mendax Reut.

On May 17, 1915, the writer, in company with Mr. C. L. Coffeen, County Agent of Elkhart County, visited an apple orchard belonging to Mr. Ed. Bartholomew of Goshen, Indiana, with an idea of conducting some demonstration spraying work there. This demonstration orchard was directly in charge of Mr. Coffeen, and my visit to the orchard was for the purpose of advising him relative to the spraying program for the summer, as well as observing the results of the dormant spray which had been applied for San Jose scale.

A conspicuous injury to the young leaves, consisting of large numbers of minute reddish spots, evidently the work of a true bug, was found, and a search revealed some small bright red insects, which were later determined as the nymphs of the false red bug. To the knowledge of the writer, this is the first record in Indiana of the occurrence of this insect in numbers to justify attention.

The resignation of Mr. Coffeen as County Agent of Elkhart County resulted in a discontinuance of the observations on the life history and work of this insect in this orchard. It is sufficient, however, to know that this bug is established in Indiana and that under favorable conditions it may become a serious orchard pest.

The following account of the life history, habits, and control of this insect has been compiled from Bulletin No. 291 of the Cornell University Experiment Station, written by Prof. C. R. Crosby.

LIFE HISTORY.

The eggs of this insect are laid in July and are usually, though not always, inserted in pairs in the lenticels of two-years-old wood. They are quite minute, being not more than one-twenty-fifth of an inch in length and not more than one-half as wide. These eggs hatch shortly after the leaves come out in the spring and before the flowers bloom.

The nymphs pass through five immature stages and attain their wings with the fifth molt. The time required for the nymphs to reach maturity, after hatching from the eggs, depends largely upon weather conditions. In a steam-heated insectary at Cornell University this was thirty-seven days. Each molt required about one week. Out-of-doors there is no question that this time would be longer. The nymphs of the false red bug resemble those of the true red bug, a rather closely related species, but are distinguished by their brighter red color and the absence of dusky markings on the thorax. The body of these nymphs is clothed with fine, short, black hairs. The nymphs of the false red bug retain their brilliant coloring until full-grown, while those of the true red bug become nearly black on the thorax with the third molt. In the false apple red bug the beak is nearly colorless, except the tip, which is black, while in the true red bug the entire beak is dusky.

The adult insect is about one-fourth of an inch long, with the head and prothorax orange red; the latter with a narrow black posterior border. The wings have a band of orange red, with the inner part dusky. The amount of red varies decidedly in different individuals, some being entirely reddish and others dusky. The eyes are red, the antennae black and the legs dusky yellow and darker near the tips.

HABITS OF THE NYMPHS AND ADULTS.

After hatching, the nymphs move to the young leaves and feed on these until full grown, in case no fruit is available. The injury is quite characteristic, consisting of minute reddish spots caused by the feeding punctures. The nymphs usually feed on the upper surface and by making numerous punctures, cause conspicuous malformation. When fruit is present, they attack it as soon as it has set, often "stinging it" so badly that it either falls to the ground, dries up on the trees, or if it remains on the trees and tends to develop, is absolutely unmarketable, because of its dwarfed, knotty and gnarled condition.

In the early stages it is hard to find the nymphs, because of their habit of hiding between the opening leaves. As they grow older they become more active, and when disturbed retreat to the twigs, where they dodge from side to side, much like a squirrel.

The injury of the adults to the fruit and leaves is similar to that of the nymphs. They also have the same dodging tendency as the nymphs, but suddenly take to flight when alarmed. Thus even in a badly infested orchard it is difficult to capture adults and nymphs. The injury to the young fruit is often very serious, but has been found to be largely confined to the following varieties of apples in New York State: Greenings, Pound Sweets, Ben Davis and Spies. In some orchards 25 per cent. of the crop has been rendered useless on account of injury, and in an orchard of Greenings the whole crop was destroyed.

CONTROL.

Since the majority of these insects hatch after the opening of the leaves of the fruit buds, and before the blossoms open, the application of a contact insecticide spray that will kill them at this time, while they are small and delicate, is advisable. Nicotine sulphate, diluted in 1 to 800, that is, 1 ounce to 6 gallons of water, or half a pint in 50 gallons of water, has been found to be effective by Crosby and Wilson. The addition of two pounds of soap to each fifty gallons of this mixture tends to increase its efficiency. It is noted from the time above mentioned that the application for the false apple red bug is the same as the first scab-bud-moth spray, as set forth in the Spray Program of this office.

Nicotine sulphate may be added to the lime-sulphur-arsenate of lead spray, in the proper proportions, without decreasing the efficiency of any of the material, hence, where false apple red bug proves to be a serious pest, nicotine sulphate should be added to the scab-bud-moth spray. It must be borne in mind that nicotine sulphate solution is a contact insecticide and satisfactory results depend on bringing it into direct contact with the insects to be killed. In other words, great thoroughness is necessary to get results in controlling the false apple red bug. A general spray directed at the whole side of the tree, leaves many parts untouched. A good plan to follow is to spray the tree branch by branch, starting at the top, following each branch down towards the trunk. Where nicotine sulphate is used alone, a fairly coarse nozzle with a moderate pressure, that is, 100 to 120 pounds may be used, but when this material is added to the scab-bud-moth spray, it will be necessary to use a finer nozzle and to take more care to drench the tree.

ONION THRIPS.

Thrips tabaci LIND.

This is one of the very serious pests with which the Indiana onion grower has to contend. During the past season there were very serious outbreaks in Knox and Marshall counties.

On August 5th, Mr. H. F. Dietz, a deputy of this office, visited the onion fields in the vicinity of Culver and Plymouth, Indiana, and found that at least fifty per cent. of the crop was so badly damaged as to be worthless. Mr. Dietz was accompanied by Mr. V. I. Safro, of the Kentucky Tobacco Products Company, and Mr. J. C. Hull, of the Friend Force Pump Company. The purpose of this visit was to find out if there was a practical method for controlling onion thrips with power outfits. Several large plantings were visited, and the following are the observations that were made:

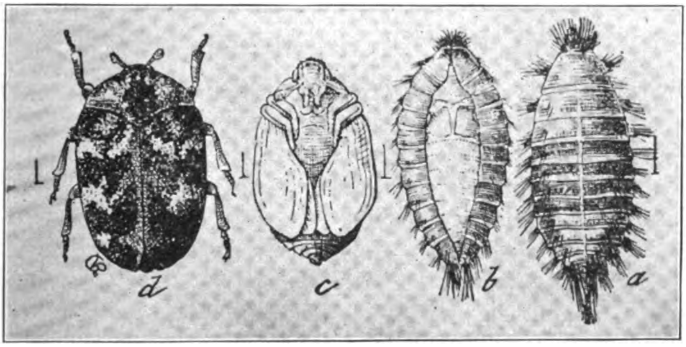
1. There was no standard distance for planting onions in this locality. Some growers plant as close as eleven inches between the rows and others as far apart as fourteen and fifteen inches.
2. The closer distances do not allow the passage of a broad-wheeled spraying machine such as it is necessary to use on the soft muck lands.
3. The past season was an especially unfavorable one, owing to the heavy rainfalls throughout the onion growing section of the State, and the soil was always soft.
4. The only practical method for onion growers to follow in the planting of their crops is to allow at certain intervals space enough for the spraying machine to pass in, no matter what type of spraying machine is used.
5. In this space potatoes or cabbages may be planted with profit.

Co-operative experiments with the Kentucky Tobacco Products Company and the Friend Force Pump Company have been planned for the next season to determine the types of spray machines and the amounts of material necessary to control onion thrips.

THE BUFFALO MOTH (*Anthrenus scrophulariae* LINN.) AND BLACK CARPET BEETLE (*Attagenus piceus* OLIV).

These two insects are discussed together on account of the similar injury produced by them and because of the similar control measures. Also the appearance of the larvae, the form which does the damage to carpets, woollens, furs, etc., resemble each other closely enough to cause them to be confused by the average housewife.

The larvae of the black carpet beetle, however, may be characterized by the bunch of long fine hairs at the posterior end and a much smaller quantity of these fine hairs scattered over its body. The "Buffalo Moth" has a tuft of hairs at the posterior end, but they are not so conspicuous as those of the Black Carpet Beetle, and a greater quantity of hairs is distributed over the body of the "Buffalo Moth" larvae.



BUFFALO MOTH.
(After Riley, U. S. D. A.).

The "Buffalo Moth" is often termed the "Buffalo Bug," which also is a misnomer, since the insect is neither a bug nor a moth, but a beetle. These pests, however, become so troublesome in households, in widely separated localities throughout the State, that in a few instances it is almost impossible to free the premises of them. In a general way, satisfactory control has been accomplished by replacing the carpets with rugs and using paint or a filler on the floors, thus doing away with cracks or crevices as far as possible.

The cracks along the baseboards have presented a serious problem, and these should be sprayed with benzine or gasoline after the dust and dirt has been scrubbed out with soap and water. Wherever carpets are continued in use, they should be loosely tacked, in order that frequent examination may be made to determine whether the insects are again getting a start and also to facilitate cleaning.

In extreme cases, fumigation with hydrocyanic acid gas has been resorted to, but this gas will not solve the problem where a number of unhatched eggs are in the house. It is doubtful whether this method of control is superior to that of thoroughly cleaning by taking the rugs or carpet outside and beating them, then thoroughly spraying them with gasoline or benzine and giving the floor and baseboards a thorough cleaning and spraying.

Those having trouble with these insects should watch the wild flowers which are often carried into the house for bouquets, as the adults of the "Buffalo Moth" are carried in houses in considerable numbers on wild flowers, particularly golden-rod.

DRUG-STORE BEETLE.

Sitodrepa panicea LINN.

Several reports from drug-stores and grocery-stores carrying a line of commodities attacked by this insect indicate that the drug-store beetle is quite a serious pest.

The reddish-brown adult beetles are one-tenth of an inch long and the wing covers as shown in the illustration are striated. The beetle has a habit of drawing its head back beneath the thorax when it is at rest. The following materials are listed by Herrick as being subject to attack by this pest: Dry beans, peas and seeds of all kinds, together with flour, meal, breakfast foods, chocolate, black and red pepper, cayenne pepper, ginger and other condiments. Herrick recommends the following methods of control:

"METHODS OF CONTROL:—Where they occur in a sack or barrel of meal or flour, they will usually be found near the top. In this case, the top of the meal or flour may often be carefully removed and fed out to animals and all of the beetles and larvae gotten rid of in this way. If the larvae have found their way up and down the sides of the sack or barrel and have penetrated a pretty good portion of the material in this way, there is not much that can be done except to use it in feeding to animals. It would be best, however, to kill the larvae and beetles by fumigating the cereal with carbon bisulfide, to make sure that none of them escape to infest other household materials. This may be done by setting a teacupful of the liquid on top of the flour in a tin dish and covering the barrel tightly. Allow it to stand two or three days in order that the gas may have time to penetrate into the flour as far as possible. In the meantime, do not go near the barrel with a light of any kind, for the gas of carbon bisulfide is inflammable and explosive."

CIGARETTE-BEETLE.

Lasioderma serricorne FABR.

The cigarette beetle, as its common name indicates, is a serious pest to cigarettes that have been packed in boxes for the trade. It also attacks cigars and other tobacco in a similar manner which results in considerable loss to the tobacco manufacturing industry.

Many retail stores in the city of Indianapolis are compelled to annually discard a considerable quantity of cigars, cigarettes which tobacco which has been worked upon by this insect. The fact that the cigarette beetle works so readily on tobaccos as indicated above, should not lead people to believe that it is in a sense a beneficial insect, since it has been reported on several household food stuffs, viz.: yeast cakes, cayenne pepper, ginger, rice, figs and other materials. The tiny black beetle is about one-sixteenth of an inch long, with minute rough hairs scattered over the wing covers. It apparently breeds continually throughout the year in infested cases, stored in stores where the temperature is favorable for its development.

This pest may be successfully controlled by heating the materials in which it is feeding to a temperature of 125 to 130 degrees Fahr. for ten to twelve hours, provided they will stand this temperature without injury.

THE DOG FLEA.

Ctenocephalus canis CURTIS.

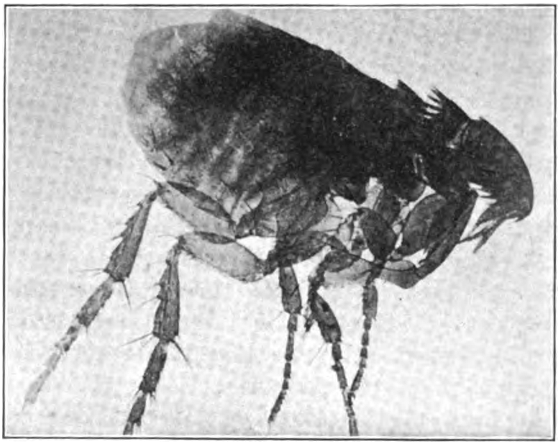
THE CAT FLEA.

Ctenocephalus felis BOUCHE.

Scores of requests were received during the latter part of the summer of 1915 from persons desiring advice for ridding their houses of fleas. A majority of these requests came from the city of Indianapolis, but no doubt many other sections of the State experienced a similar epidemic—as damp weather such as that of last summer is favorable for the development of fleas.

The most serious house infestations in Indianapolis were instances where the family had left the city for the summer vacation and the house was locked up and left undisturbed for a month or more—thus producing an ideal condition for the eggs to hatch. In all cases the source of the trouble could be traced either to a pet animal or to a tramp dog or cat which found a sleeping place under the house or porch or in the basement—from which places the fleas got into the house.

The following means of suppression is quoted from Farmers' Bulletin No. 638. We have advised and practised these control measures in a general way for the past few years and find that in cases where poor results have been obtained, it is due to the lack of thoroughness of the work.



FLEA.
(From Surface's Bi-monthly Bul.).

"MEANS OF SUPPRESSION.

"One of the most successful methods of killing fleas on cats and dogs is to wash the animals thoroughly in a tub containing the proper proportion of a saponified coal-tar creosote preparation, of which there are a number on the market, known as 'stock dips,' etc. The animal should be thoroughly scrubbed, making sure that the fleas on the head are well soaked, as many rush there to get away from the parts that are covered with the solution. After the animal has been in the bath for about five or ten minutes, it may be removed and allowed to dry. In the case of cats, especially if tender-skinned, the preparation may be washed out of the fur with soap and warm water soon after the animal is taken out of the solution.

"In addition to the destruction of all fleas present, this accomplishes the cleansing and deodorizing of the fur and also aids in the healing of any wounds which are present.

"Other methods of destroying fleas on cats and dogs have been recommended. Among these the careful rubbing into the hair of powdered naphthalene or moth balls has been found effective. Pyrethrum or Persian insect powder is used in the same way. Both of these materials stupefy the insects and cause them to come to the surface of the hair or actually drop out. The animals should be treated on papers spread on the floor and the insects burned after the dusting is completed.

"Fleas on hogs may be destroyed by dipping the animals in a vat containing some of the creosote dips as used for the hog louse or by sprinkling crude petroleum on them when they are eating.

"CONTROL OF HOSTS.

"In order to avoid the infestation of houses, it is important to keep all animals from beneath dwellings. In such situations breeding may progress rapidly, and it is very difficult to treat the breeding places. If fleas are continuously annoying about the household, it is often desirable not to admit cats and dogs at all, but to provide regular sleeping quarters for these animals out-of-doors, and prevent flea-breeding by methods suggested in the following paragraph. Stray cats and dogs should not be encouraged about the premises. In towns and cities the enforcement of the dog-tax law and the destruction of all untagged animals will tend greatly to reduce house infestations. It is also desirable to keep different kinds of animals which are subject to flea infestation separated, and care should be exercised that infested animals are not brought to clean premises.

"DESTRUCTION OF FLEAS IN IMMATURE STAGES.

"Following the ridding of infested animals of adult fleas, it is important to destroy the immature ones which are constantly becoming full-grown and reinfesting animals. In household infestations it is usually found that the breeding takes place in the cracks of floors or beneath carpets or in rooms which are not frequently swept, but which may be visited by pet dogs and cats. The carpets and rugs should be removed, the floors thoroughly swept, and all of the dust thus obtained burned, as it contains many of the eggs and maggots of the fleas. The floor should then be scrubbed with strong soapsuds or sprinkled with gasoline, taking care to avoid having fire about during this procedure. After the floor coverings are thoroughly aired and beaten they may be returned, but it is desirable before putting them down to sprinkle the floor with naphthalene crystals or pyrethrum powder.

"In flea-infested regions it is advisable to avoid the use of mattings and carpets. These may be supplanted by rugs or oiled bare floors. This permits frequent sweeping of the floors and makes the destruction of the immature stages easier if an infestation becomes established.

"Among other methods for destroying the fleas in houses the following have been tried and are recommended: Scatter five pounds of flake naphthalene over the floor of an infested room and close tightly the doors and windows for twenty-four hours. After this time the naphthalene may be swept into another room, and so on, thus making the treatment inexpensive. The free use of alum, both in the powdered form sprinkled over carpets and rugs and by dipping papers in an alum solution and placing them under the rugs, is said to give satisfactory results. The fumigation of houses with sulphur fumes or hydrocyanic acid gas also accomplishes complete destruction. In addition to killing all of the fleas, rats and mice are destroyed by these last-mentioned methods. In using sulphur the infested building should be closed up tightly and the material used at the rate of four pounds to each 1,000 cubic feet of space. If the immature stages have been destroyed by the methods mentioned above, two to three pounds of sulphur per 1,000 cubic feet of space will be sufficient to destroy the adults. The sulphur is made into a cone shape in a good-sized pan or kettle and placed in a larger pan containing water to avoid danger of fire from the heat generated. A little alcohol is then poured into a depression made in the top of the cone of sulphur and a match applied. Each room should have a pan of sulphur, and the rooms should be kept closed about twelve hours. As the gas generated corrodes metals and injures plants, it is necessary to remove metal objects and potted plants before fumigating. It is not advisable for any one to undertake the use of hydrocyanic acid gas without obtaining the complete directions for its employment as outlined in Farmers' Bulletin No. 699, entitled 'Hydrocyanic Acid Gas Against Household

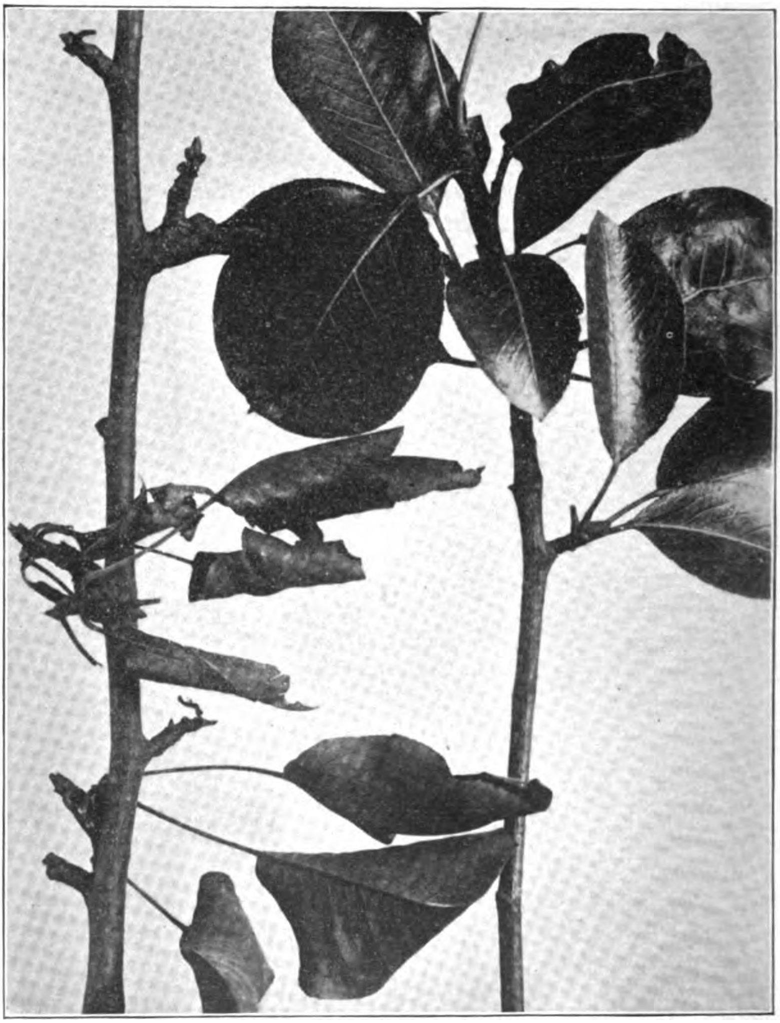
Insects.' This gas is very poisonous, but is one of the most satisfactory for destroying all sorts of vermin in buildings.

"When house infestations are derived from fleas which breed beneath or around houses, the first step is to clean out all loose material in which fleas may be breeding and burn it, and then to use crude petroleum freely about the breeding places. This may be followed by scattering common salt about and thoroughly wetting it down. The free use of lime on the cleaned areas also apparently destroys immature fleas. In exceptional cases lawns become infested, and fleas breed out around the roots of the grass. It is impracticable to apply chemicals in such situations, but much may be done to check the breeding by cutting the grass exceedingly short and thus exposing the young fleas to the heat of the sun, which will usually accomplish their destruction. In certain sections it has been found feasible to destroy flea infestations in barns and hog runs by diking the infested areas and pumping water in so as to flood them entirely."

DISEASES OF THE YEAR.

FIRE BLIGHT.

Bacillus amylovorus (BURR.) DeT.



FIRE BLIGHT.

Perhaps no two other plant diseases together attracted as much attention last season as fire blight. This disease has become one of the most serious apple diseases with which the grower has to contend. One can never tell just when there will be an outbreak, because the wintering over stages of fire blight are largely influenced by climatic conditions. There may be a very serious outbreak one year, but the next year there may be scarcely any signs of the disease. Consequently the grower is not certain what will happen to his trees.

Fire blight has proved to be especially troublesome in apple nursery stock and young apple orchards. It has been such a serious disease on pears and quince that the growing of these in Indiana has been largely abandoned.

There has been considerable controversy regarding the varietal susceptibility of fire blight in apple and also the best methods for controlling this disease. Whetzel and Stewart claim that there is no varietal susceptibility as the results of carefully planned laboratory experiments. From our observation made in the vicinity of Paoli, Indiana, on large young orchards, we could not agree with these results when applied to field conditions. Our observations showed that Jonathan and Yellow Transparent are particularly susceptible, whereas the Duchess and Stayman Winesap in the same orchard and in adjoining rows were scarcely affected.

From 33 per cent. to 50 per cent. of the former trees were affected by this disease, while from 10 per cent. to 15 per cent. of the latter showed injury. The reason for this apparent immunity on the part of the Duchess and Stayman Winesap has not been determined. It was found that trees infested by the apple leaf hopper (which were the Jonathan) showed the greatest amount of blight. Whether this was coincidence or the result of insects carrying the disease, has not been experimentally determined.

Tarnished plant bug was very abundant in this locality, and ants were found quite abundant between the rows. Both of these insects have been suggested as the carriers of the blight, but this office has done no work in determining the role they play in the dissemination of this disease.

Observations on the control of blight by summer pruning were carefully watched throughout the season in this same vicinity. Our observations show that unless there is community action in summer pruning no results can be hoped for. However, we doubt the advisability of summer pruning unless every canker is removed, no matter where it appears. This means that trees must be mercilessly butchered and there is a question whether it is more advisable to let the blight kill the trees than to kill them by such ruthless pruning as is necessary.

Again, in large orchards it is almost impossible without the aid of trained help to control blight. In this locality it would be impossible to get enough of the kind of help necessary to do the work.

In an orchard in high state of cultivation on which summer pruning was practised, trees were practically ruined through summer pruning. This doubtless was largely due to the fact that not all cankers were taken out and the blight germs gained entrance to the wounds even though they had been sterilized with corrosive sublimate. Our conclusions from the present season's work are that varieties most susceptible to injury, such as Jonathan and Yellow Transparent should not be planted except in isolated blocks and special control measures may be taken to keep them free from insect carriers of the disease.

Another method of control that suggested itself as most practical is to remove all blight cankers in the late fall or winter after all danger of spreading the disease has passed. The cankers will be clearly marked at this time, and there is no danger of the disease being more than two or three inches back of these cankers. We would also advise the removal of blighted twigs as it has not yet been shown that these do not hold over the disease during the winter.

ILLINOIS BLISTER CANKER.

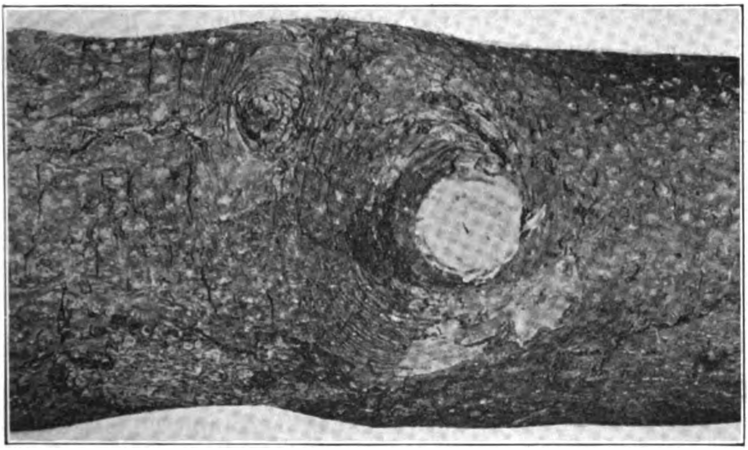
Nummularia discreta (SCHW.) TUL.

This disease has without doubt been to a certain extent destructive in Indiana for a great many years, but since a more detailed study of the disease has been made its progress in various orchard sections has been noted with much interest.

Blister canker is a wound parasite and the infection takes place through breaks in the bark caused by picking ladders, whiffle trees and unprotected pruning wounds. It is obvious that careless pruning is responsible for more injury from this disease than any other one cause. The writer observed an orchard in Putnam County, last season, where it killed almost all the trees. The orchard owner had a mistaken idea as to how the branches should be cut off and left a short stub where each branch was removed, thus making normal healing impossible. These exposed wounds were excellent places for blister canker to get a foothold, and the killing effects of the disease were very evident.

In branches where the disease extended only part way around, the sap flow was so interrupted that the foliage presented a weak and stunted appearance and in many cases the growth started off in a normal manner in the spring, only to wither up and die before the middle of the summer.

This disease is serious, particularly in older orchards, and must be reckoned with in order to obtain the profits that these older orchards ought to be yielding. The early stages of the disease should be recognized and the cankers cut out in the same manner that is recommended for cutting out branch cankers caused by black rot. This cutting out of the incipient cases, removing branches more seriously affected and burning the refuse, together with the proper use of disinfectants and wood preservatives on the wounds should be conscientiously practised, particularly in orchards where the disease has gained more or less headway.



BLISTER CANKER.
(Original.)

APPLE SCAB.

Venturia inaequalis (CKE.) WINT.

Apple scab is considered in the United States as a whole as the worst disease with which the apple growers have to contend. In Indiana, however, it is not to be compared with blotch and in seasons such as the two just passed, fire blight has been much more of a problem than has apple scab. Scab was generally prevalent throughout the State during the past season, which was a favorable one for the development and spread of this disease, but during the preceding summer, it was difficult to find specimens of scab even on unsprayed trees. The early summer spray applications are the important ones to prevent scab from getting a start on the foliage and throughout Indiana these early applications, with the combined insecticide and fungicide are essential in the control of injurious insects and other fungous troubles. With seasons favorable for its development, however, it would cause thousands of dollars of loss were not the fight against scab and other diseases kept up. During cold wet periods early in the season, scab is a destructive disease on young nursery stock. Nurserymen, however, are inclined to pass it by as not being important, but those who consider the bad effects of the loss of foliage caused by scab and take steps for preventing the leaf infection, reap the benefits of their work by the increased caliper they get in their young trees.

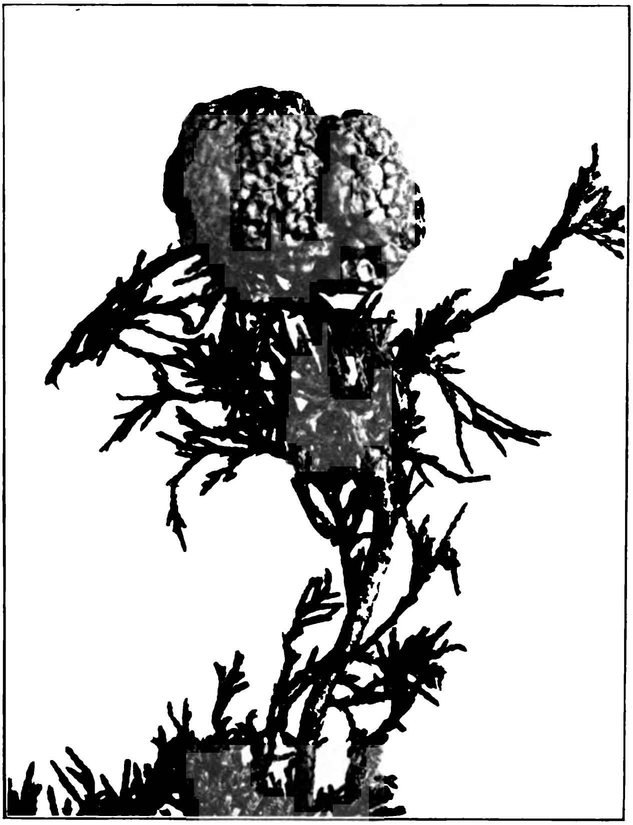
CEDAR RUST.

Gymnosporangium macropus LINK.

This interesting disease is quite serious every season in sections of Indiana where the Red Cedar is found. The fungus requires two hosts in order that its life cycle may be completed. It winters on the Red Cedar (Juniper) and causes an abnormal growth, commonly known as "cedar apples." These apples produce gelatin-like tentacles when the warm spring rains come, and from this gelatinous material millions of spores are produced. During dry weather following, the spores become like little particles of dust and are carried by the wind a considerable distance, and those alighting on the foliage of the cultivated apple or on closely related wild species will in the presence of moisture germinate and produce the well known rust spots on the leaves. Unsprayed orchards located near a number of cedar trees are often almost totally defoliated by the middle of July. Those which are only partially defoliated are rendered less efficient in the production of wood and fruit.

Cedar rust, like apple scab, becomes quite serious in nurseries where it is necessary that the foliage be kept in a healthy condition in order that the proper growth of the young trees may be made.

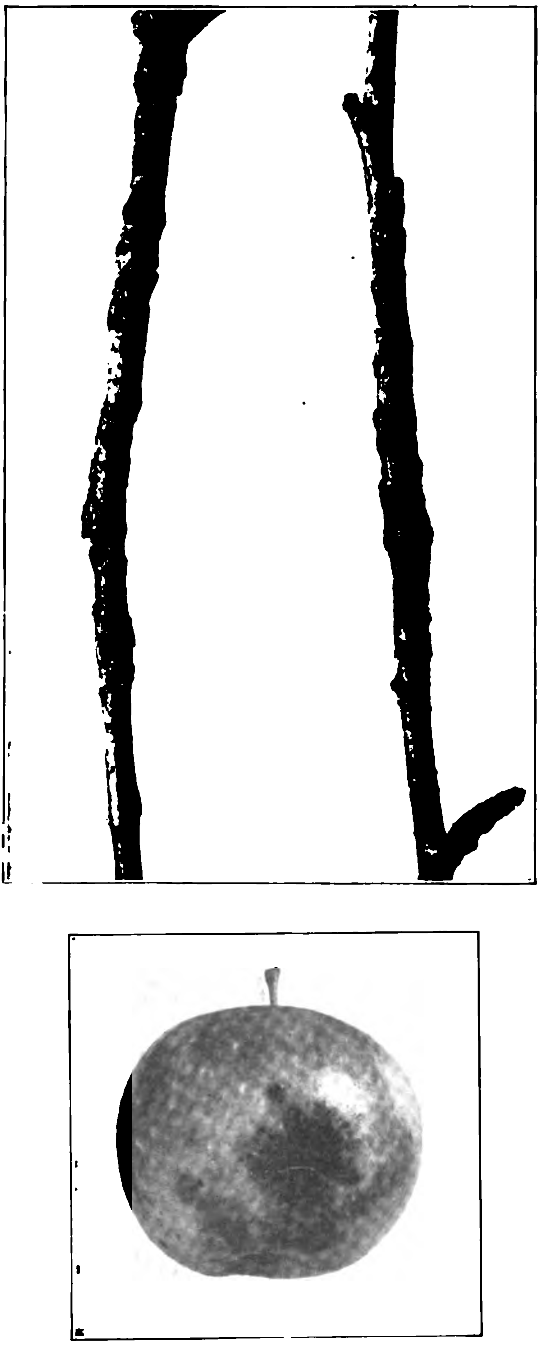
There is a marked susceptibility of certain varieties, chief among those seem to be Wealthy, Jonathan, Red June and Missouri Pippin, which are particularly subject to cedar rust. Those showing considerable resistance are Maiden Blush, Yellow Transparent, Winesap, York, Gano and Ben Davis.



CEDAR RUST. CEDAR APPLE ON RED CEDAR.

This disease presents a serious problem in the southern half of the State where orchard development has been going on in recent years and many growers are feeling the need of some legislation which will give them protection from the source of infection located on neighboring land.

It is obviously much more simple and effective to remove the source of the trouble, viz., the red cedar trees, than it is to prevent the disease, from becoming established on the apple leaves.



APPLE BLOTCH ON TWIGS AND FRUIT.
(Original.)

APPLE BLOTCH.

Phyllosticta solitaria ELL. & EV.

Indiana growers lost severely from apple blotch during the past season. The better growers have for some time recognized the superiority of Bordeaux Mixture as a fungicide against this disease, as recommended by this office, and have substituted this material for lime sulphur for an application early in June.

The experience of many growers during the past season which was a very favorable one for the development of this disease, indicates that an earlier application of Bordeaux is important. The tendency has been to watch the fruit for the appearance of the first tiny brown spots on the skin and then go ahead with the Bordeaux spray. On varieties such as Mann, Smith's Cider, Northwestern Greening, Maiden Blush and others, which are badly affected, the spray should be applied in the southern half of the State as early as the 25th of May—before the disease shows at all on the fruit.

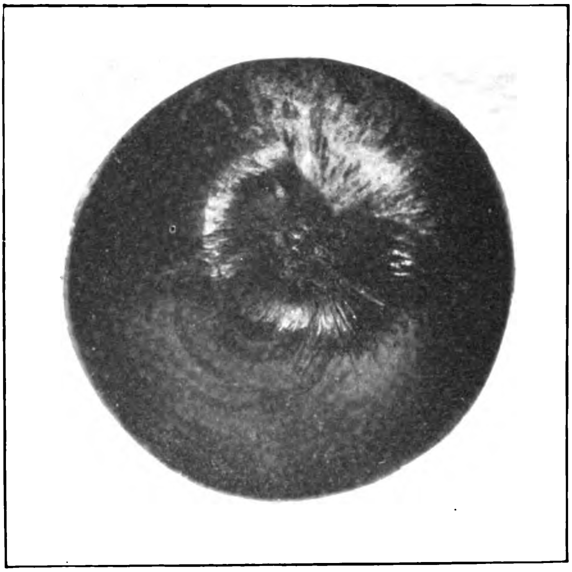
The difficulty encountered by those who have had experience in the control of fungous diseases when control measures are started after the disease has begun, makes it very evident that the main reason for lack of success in the control of this disease is the late date on which spraying is begun.

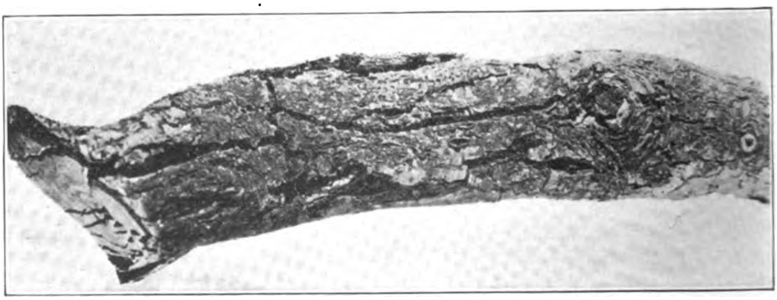
Examination should be made on those trees for blotch cankers on the twigs and these cankers should as far as possible be removed by winter pruning. In orchards containing such resistant varieties as Jonathan, Winesap, York, it may be advisable to apply the blotch spray only to those trees affected with the trouble the previous year.

BLACK ROT.

Sphaeropsis malorum PECK.

Black rot cankers are found in nearly every apple orchard in the State. It has become quite serious as a branch canker as well as a leaf and fruit disease. With the ordinary spray schedule as practised by the best growers little loss is suffered from the disease aside from the branch cankers. These should be pruned out in the same manner as is recommended for the pruning out of Illinois blister cankers. With favorable conditions for fungous growth a considerable percentage of the fruit is attacked. Some of these decayed specimens hold on to the tree and appear as black shriveled mummies and furnish a source of infection the following year. These diseased apples therefore should be removed.



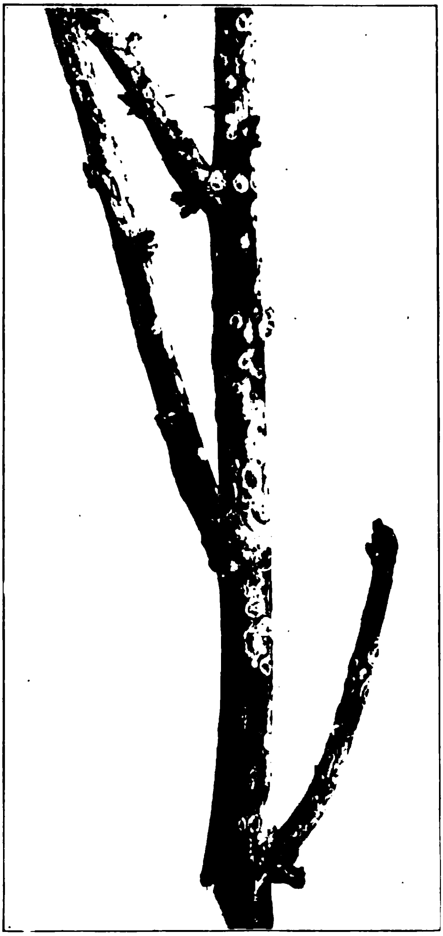


BLACK ROT ON FRUIT AND LIMB.
(Original.)

STRAWBERRY LEAF SPOT.

Mycosphaerella fragariae (Tul.) Sacc.

Leaf spot of strawberries is found to a greater or less extent in all plantings. The spots are at first small and are inconspicuous, but as they increase in size, it is not unusual to find the whole leaf affected in varieties such as the Mammoth and War-field. Bubach, Gandy and the Haverland are less subject to the trouble. Bordeaux, 4-4-50 applied when the spots first begin to appear will check its spread for a few weeks. During rainy seasons, however, the effect of the fungicide will be lost in about two weeks and later applications are necessary.



RASPBERRY ANTHRACNOSE_ON CANES.
(Original.)

RASPBERRY ANTHRACNOSE.

Gloeosporium venetum SPEG.

With the possible exception of crown gall there is perhaps no other disease which causes so much loss to small fruit growers as does anthracnose. The disease may appear on the leaves and the leaf stems, but it is most serious on the canes, where it causes scabby appearing areas which sometimes extend all the way around the cane, thus cutting off the normal flow of sap.

The outlook for a good crop of fruit will be promising until anthracnose develops sufficient to diminish the sap supply, and it is not unusual to find a good crop of fruit set and partially grown only to shrivel up as a result of this disease. The small canes become infected and with favorable weather conditions the berry growers may expect an unusual amount of trouble next year, as the disease often gets started on the young canes, and becomes destructive the following season when the canes are fruiting. An application of strong Bordeaux early in the spring, just as the young leaves are starting, and close watching to remove diseased canes, together with the rotation of crops are the successful remedial measures for this trouble. Good care should be exercised by the planter in securing his new plants from patches not affected with this disease.

DOWNY MILDEW ON GRAPE.

Plasmopara viticola (BERK. & CURTIS) BERL. & DETONI.

Downy Mildew was unusually prevalent and destructive last summer and was not confined entirely to foliage, but gave trouble on the partially grown fruit, and in some instances was noted affecting full grown berries. The disease is commonly called "Downy Mildew" on the leaves, and when the immature fruit is affected it is termed "Gray Rot." The same disease is called "Brown Rot" when full grown berries are attacked. These common names are descriptive of the appearances of the disease. Partial defoliation was very common and in a few instances almost total loss of leaves resulted from Downy Mildew. Bordeaux Mixture applied thoroughly at the time the disease first shows itself is an effective control measure. When the trouble is serious, near the ripening season for the grapes, ammoniacal copper-carbonate should be used instead of Bordeaux, as the latter shows too conspicuously on the ripening fruit.

YELLOW-LEAF OF CHERRIES AND PLUMS.

Cylindrosporium padi KARST.

Cherry trees in Indiana, both sweet and sour varieties, very often suffer severely from this trouble, which attacks the leaves, eventually causing them to turn yellow and drop. The nurserymen gave particular attention to the control of the disease early in the season. It is a general practice where a sufficient caliper is attained to cease spraying for this trouble and allow the tree to become prematurely defoliated, thus checking the growth and producing a well ripened wood for fall planting.

In orchards of bearing trees, however, it is not desirable that the foliage be lost prematurely, since the fruit bud development, which takes place during the summer, depends materially upon the presence of a healthy foliage.

It was not an unusual sight in cherry orchards throughout the State last summer to see the leaves entirely gone within a month after the fruit was harvested. These trees must necessarily suffer and a small crop of fruit next year will indicate the injurious effects.

This leaf spot can be readily controlled with diluted solutions of lime sulphur, self-boiled lime sulphur solution, or with Bordeaux Mixture. The lime sulphur solutions are preferable on tender varieties that may be injured by Bordeaux.

SYCAMORE BLIGHT.

Gloeosporium nervisequum (FCKL.) SACC.

Sycamore Blight was quite serious throughout the State during the spring of 1915. Numerous dead leaves were noticed scattered throughout the sycamore trees. Investigation showed Sycamore blight to be the cause of the trouble. Severe cases resulted in almost total defoliation. In milder cases the affected trees presented an unsightly appearance as the brown leaves held to the trees for some time. The disease can probably be successfully controlled by the use of Bordeaux Mixture, but it is questionable whether the application of a spray to large trees would be justified.

NECTRIA CANKER.

Nectria cinnabarina (TODE) FR.

During the summer of 1915 our attention was directed several times to dead branches caused by this disease. The trouble may be found on nearly all deciduous trees, but our observation showed that the different species of maple are most susceptible.

Nectria is a wound parasite and may affect the branches or trunk of a tree or the roots. The remedial measures discussed in the control of Illinois Blister Canker are applicable in the control of this disease.

REPORT OF THE STATE INSPECTOR OF APIARIES FOR THE YEAR ENDING OCTOBER 31, 1915.

The following is a summary of the work for the past year:

Number of apiaries visited	206
Number of colonies inspected	2437
Number of cases of American foul brood found	289
Number of cases of European foul brood found	33
Number of diseased hives burned	54
Number of cases of foul brood treated	83
Number of cases of paralysis found	5
Number of cases of pickled brood found	6
Number of cross-combed hives found	43
Number of box hives found	15
Number of barrel hives found	2

A few words of explanation of the above may well be inserted here. From the number of cases of American and European foul brood found it might be inferred that the European foul brood is scarce in Indiana. While European foul brood is not as virulent at present as it has been in the past, due largely to the introduction of a large amount of Italian stock, yet there are certain parts of the State in which European foul brood is particularly bad. It so happened this year that the inspectors did not spend a great deal of time in those localities. The American foul brood still continues to decimate the colonies of Indiana beekeepers. Those who have made conscientious efforts to overcome the disease have succeeded very well, but in nearly every community there are those who either do not care or are too careless in the work of treating for the disease. The weather of the past season, as all beekeepers appreciate, was not favorable to the handling of bees. The work of inspection was very greatly interfered with, as the table above shows. However, a number of communites where disease was particularly bad were visited with gratifying results. The statistical table above shows that the number of box hive beekeepers are gradually being eliminated. Some of them have learned that the moveable frame hive pays while others have been eliminated by the foul brood route. It is pleasing to note the decrease.

Within the last year we have made an effort to obtain definite statistics regarding the scope of beekeeping in this State. If it happens that this report falls into the hands of any beekeeper whom we have not solicited in this matter, it is hoped that he will at once write us, stating the number of colonies kept, the average yield per year, and whether or not foul brood is present in the locality. As near as we have definite knowledge, there are more than 8,200 beekeepers in the State. There are many more than that number, but we have thus far been unable to get in touch with them. To all who send us these statistics, together with the names and addresses of their neighbors who keep bees stating how many colonies they keep, we are glad to send them a copy of our bulletin entitled "Information for Beekeepers." This bulletin discusses the basic principles of beekeeping and is written particularly for the amateur. From the statistics at hand we find that there is an average of 13.2 colonies per beekeeper. This average is doubtless higher than the facts justify, for it is our experience that we receive responses from the larger beekeepers more readily than from the smaller ones, thus explaining the large average.

There are not many people who are dependent upon beekeeping for their incomes. There are a number of reasons why beekeeping is not a business to which one is likely to devote himself exclusively. Some of those reasons are as follows:

One of the most important of these is the uncertainty of the honey flow. It so happens that, in this State, we have one year in which we have an exceptionally good crop of honey, and that year may be followed by one or several years during which the yield is very small, even to the point of being unprofitable. One of the contributing factors to the uncertainty of the honey crop and the small yield per year is the fact that a large part of the basswood timber of the State has been removed. Formerly those colonies which were not strong enough for storing surplus honey during clover bloom would build up and be in good condition by the time of the basswood bloom. Now, with the basswoods gone, excepting in favored localities, those colonies that do not store surplus during clover bloom are not given an opportunity later unless there happens to be a fall flow. In the northwestern part of the State, as well as in scattered locations in other parts of the State, the swamps are being drained. These lowlands are being broken up. They are being planted into cultivated crops and thus one of the important sources of nectar is removed from the beekeeper. This condition is counterbalanced somewhat by the fact that after the swamp lands are broken up they usually produce valuable crops of heart-weed or spotted smartweed. This plant yields bounteous crops of honey of a good color and flavor, although it is far from being equal to white clover.

Anyone who is making a specialty of the bee business finds that there is a scarcity of skilled labor along this line. That is because beekeeping is one of the minor occupations and one in which the proprietor usually does all the work. A beekeeper whose business is of such a scope that he is required to hire help, finds that he is compelled to pick up assistance wherever he can, train it at his own expense, and try to hold it as long as he can. Quite frequently, when the help is trained sufficiently to be of value, they conceive the idea of keeping bees themselves, and the beekeeper finds that he must look for some new assistants to train.

The marketing problem is a very important factor in beekeeping in all parts of the State. There are many places where it is not possible to make beekeeping a specialty and dispose of all the product on the home market. In many places the towns are small and the number of bees kept is comparatively large. Producers in such locations should look to other nearby towns for a market, and in this connection should grade their honey so that it may be a fit competitor for the honey sold there. Indiana beekeepers do not in general practice careful grading. It is a well-known fact that the more uniform a product is the higher the price that can be obtained for it. If the beekeepers would make a determined effort to dispose of their product in their home markets or the markets of the larger cities near them, there would be no surplus of Indiana honey to help hold the price down to the point of being unprofitable sometimes. It is, in general, the surplus that determines the selling price of the whole crop. Too many beekeepers seem to get an annual scare about the time the crop is taken from the hives. They rush their honey into the large markets and create an unnatural glut which in turn reacts upon the men who are responsible for it and they receive a correspondingly lower price than if they would not be in such a hurry to dispose of their honey. Wholesale houses or jobbers sometimes assist in the panic of the producers by holding out dark forebodings for the future prices of honey. Obviously, the jobbers profit immensely by this condition. Many producers are deceived by the market reports in the bee journals because they believe that, when they ship their honey to the jobber who issued the report, they will receive the price that was quoted in the report of the markets. The facts are that the prices quoted are usually the prices that the jobber is selling at, and must include his profit or commission, storage, freight, drayage and various overhead expenses. Ordinarily, the average beekeeper would make much more out of his crop by developing his home or adjacent markets.

A number of people have become discouraged and have quit keeping bees on account of foul brood. Hundreds of people in Indiana do not keep bees now and likely will not again on account of the trouble they have experienced with this disease. This condition applies more particularly to the small beekeeper who has very little at stake and does not care to experience all the trouble that is necessary to cure the disease or keep it from spreading when it gets into his apiary. Foul brood is playing its part in placing the honey business in the hands of specialists. Whether or not it is for the best the future will determine. It seems to the writer, in view of the present prevalence of disease and present inefficient methods of production and distribution, that the tendency toward the production of the honey in large apiaries is for the best of the beekeeping profession and for the public in general.

In connection with the tendency towards larger and fewer apiaries, the question of capital may fittingly be mentioned. Most of the producers of the State who have the expert knowledge essential to being one of the large producers are hampered by the lack of sufficient funds for financing a business of large dimensions. Considering the risk of failure of the honey crop here, it does not seem best that many beekeepers attempt to secure their entire income from bees. It seems best that bees should be kept only as one of the main items of a business yielding an income more than adequate for one's needs, otherwise the owner would find himself in financial distress in years of failure. The old adage of making haste slowly is nowhere more applicable than in the bee industry. Too frequently people have persuaded themselves that they are capable of properly caring for a hundred or more colonies when, in truth, ten would have been sufficient for one of their experience. Good business judgment is of inestimable value, as in any other line of business. When it is found lacking in a degree, that person should try to correct the deficiency as far as possible. Those who cannot sell at retail to advantage should retire from the home market and sell to the wholesale trade. Too often comparatively large producers are selling in a retail way at about the same prices that the wholesalers would pay and they are killing the home market that could be made to pay a fair return to anyone who would properly cultivate it.

One line of work that the beekeepers as a whole should be interested in is the effort that is being made to place the teaching of the uses of honey in the Domestic Science Departments of the schools of the State. As the students now in school are the honey buyers of the future, it is to the interest of the honey producers that this line of advertising be carried as far as possible.

One thing that the producers might profitably consider is the matter of more attractive and more sanitary honey packages. It is a matter to which all food producers are now giving their attention. There are laws regarding the sanitation of foods in restaurants and in stores and the producer of honey should anticipate the attitude of the buying public enough to place on the market only attractive and sanitary honey.

There is an inexcusable amount of price cutting among the honey producers. A number of instances have come to the writer's attention where producers in the same county have started to undersell each other. That condition can only lead to one or both of them giving up the business, for no one cares to sell for a great while at or below the cost of production. Too many do not count the cost of their time spent in selling. Every producer should charge against the honey the amount that it would cost to hire it sold and get such a price that one could hire help. These remarks refer particularly to those who are selling to the consumer.

Because the manufacturers of bees' supplies are large and powerful organizations does not appeal to the writer as sufficient cause for refusing to hold up some of their unfair practices to the gaze of those who are their victims. It is a well-established and just custom that if a person sells to a grocer, it is unfair to sell to his customers. Too many beekeepers have bought nice orders of supplies from manufacturers with which to produce their honey, and when marketing time has come they find that the supply manufacturer has also supplied the stores with honey. There is another instance of a manufacturer furnishing honey to peddlers who sell to the consumers in direct competition with the beekeeper whom this manufacturer has sold supplies to and whom he will be disappointed in when it comes to selling supplies again. But the beekeeper is in a measure responsible for this condition of things. If the producer would have enough honey to sell to his trade so that he could supply the demand throughout the year, the agent of the supply manufacturer would not find business good enough to warrant a return trip. It may be necessary for producers to buy from other producers in order to have enough honey to go around, but it should be done. A business which has two weeks of boom and fifty weeks of depression needs some remodeling. Beekeepers would do well to cultivate salesmanship. One may be a first class producer and a poor salesman, and find beekeeping unprofitable where, if the salesmanship were improved, the business would be successful. The honey business will not be the stable business that it ought to be until those who are selling to the trade will arrange to carry a stock throughout the year. It must be put upon a plane with other established businesses.

Indiana trade is not hard to sell to. Living in the famous white clover belt, most people are familiar with the high quality of Indiana honey. Indiana has a body of citizens that are intelligent and able to discriminate between Indiana and western and southern honey, especially if the producers will call their attention to the chief points of difference. Indiana has a very large number of skilled mechanics and other workmen who are able and glad to buy honey if it is placed before them in an attractive form. Most of the local advertising must be done by the local producer.

There are forty cities in Indiana having a population of 5,000 or more people. Every one of these cities are home markets for some producer or are markets that can be developed profitably by some producer. Very few of these forty cities are supplied with honey as they ought to be. There are scores of smaller towns running from one to four thousand in population that are good markets. If markets of this size would not care for all the product of one producer, it is entirely possible to work several of these towns. The honey consumption in Indiana could be more than doubled in one year if the producers would just push their business a little more. It is the surplus that holds the price of honey down. If every producer in the State would sell all that he produces without throwing it on the wholesale market, the price of honey would appreciably stiffen the first year. There is car after car of honey shipped into Indiana every year. Much of this is Indiana honey that was shipped out to the wholesale markets and then reshipped to the retailers. Indiana ought to produce every pound of honey that is consumed within its borders. If the box hive beekeepers and others as shiftless in the business could be bought out and those bees placed in the apiaries of men who know how to produce the largest crops, the yield of Indiana honey would double within two years. That Indiana does not produce as much honey as it consumes is not because we do not have the bees or the flowers, but because we do not have enough men who know how to get good results with bees. There is a vast difference between a beekeeper and a bee owner. We ought to distinguish more carefully between the two.

One thing that the Division of Apiculture of the United States Department of Agriculture has emphasized more than anything else in the last couple of years, is the matter of proper winter care for the bees. The winter care ought to begin in the early autumn with the doubling up of the small swarms. This should be followed by feeding whenever necessary. In locations where the white clover is the principal source of nectar, it is almost always necessary to feed in order to insure the wintering of a large per cent. of the colonies. If a farmer would lose from ten to fifty per cent. of his live stock during the winter, he would feel that he was sorely in need of some help along that line, but beekeepers keep on sustaining that loss and do not seem to think that there is anything very abnormal about it. Bees ought to be wintered with less than one per cent. of loss. But in order to do this the colonies must be properly prepared for winter and then given sufficient protection from the cold. Bees may be protected during the winter by cellar wintering, double walled and packed hives, or simply by giving additional protection to the common hives without moving them from the summer stands. This last item is commonly handled by providing winter packing cases made to hold one or more colonies or by wrapping each colony with slaters' felt, inside of which several bushels of leaves, planer shavings or some sort of insulator may be placed. The subject of wintering is entirely too large to take up here, but it might be well to give the essential points in good wintering. They are, a good queen of the current season's rearing, a large number of bees, most of which are young, sufficient good stores and an abundance of protection from the cold and wind.

THE HORTICULTURAL AND BEE INSPECTION LAWS OF INDIANA.

WITH A RESUME OF THE NURSERY INSPECTION LAWS OF THE OTHER STATES AND CANADA.

The publication of this section of the Eighth Annual Report has been made necessary by a general demand for information concerning the horticultural and other laws pertaining to the duties of this office together with the rules and regulations incidental thereto, as well as the requirements existing in other states governing the transportation of nursery stock into these states.

For nurserymen, dealers and agents engaged in the sale of nursery stock in Indiana, attention is particularly called to the law passed by the 1915 Indiana Legislature.

Notwithstanding the fact that this law is quite clear in its wording, this office has received a great number of inquiries concerning the meaning intended in various sections of the law. Many applicants for agent's licenses fail to state the firm or firms they represent. This information is necessary before issuing the license as it has been our experience that several concerns located outside the State of Indiana who have agents representing them in this State have neglected to comply with the law's requirements. In all instances, however, where our requirements have not been complied with by nurserymen located outside the State of Indiana, it has been due either to oversight on the part of the nursery or lack of information as to our requirements.

The operation of this license law during the past season has without doubt resulted in a great deal of protection to the buyer, as we now seldom hear of agents or dealers attempting to work any of the well-known systems of fraud and misrepresentation in connection with the sale of nursery stock.

HORTICULTURAL AND BEE INSPECTION LAWS OF INDIANA.

The following is a complete text of all the horticultural and bee inspection laws of Indiana which apply in any way to the office of the State Entomologist.

(*Acts of 1899, Chapter CXXXVIII, Page 226, Section 8.*)

"Whenever a nurseryman, agriculturist or fruit grower in this State shall know or have good reason to believe that his trees, shrubs, vines or plants are affected with San Jose Scale, yellows, rosette or other injurious insects or fungus enemies, he shall have the privilege and it shall be his duty to notify the State Entomologist, who shall proceed in person or by his assistant to examine the same without delay, and advise the proper remedies for the destruction of such insect or fungus enemies as may be present. In case the owner or owners or person in control of said affected trees, shrubs, vines or plants do not apply the proper remedies recommended by said State Entomologist within a certain specified time, the owner or owners or person in control shall be liable to a fine of not more than $25.00 or less than $10.00 and costs in the judgment of the court, for every such offense, the fines to be recoverable in the same manner as provided for in section five of this act: Provided, That in case of objection to the findings of the State Entomologist an appeal may be taken to the circuit court whose decision shall be final. Said appeal must be taken within three days and shall operate as a stay of proceedings until it is heard and decided."

Section 5 of this act provides that the above fine is "recoverable before a Justice of the Peace or before a Grand Jury."

(*Acts of 1907, Chapter 177 Page 291.*)

STATE ENTOMOLOGIST—APPOINTMENT—SALARY—CLERK.

Section 1. *Be it enacted by the General Assembly of the State of Indiana,* That the Governor shall appoint a State Entomologist, who shall be a competent entomologist and versed in practical horticulture. Said State Entomologist shall be appointed for a term of four (4) years: Provided, That the Governor may remove said State Entomologist at any time for cause. In case of the death, resignation or removal of the State Entomologist the Governor shall appoint a successor to fill out the unexpired term of four years. The State Entomologist shall receive a salary of $1,500.00 per annum and necessary expenses while traveling in the actual discharge of his duties. All such expenses shall be duly itemized and sworn to by said State Entomologist. The State Entomologist shall appoint a clerk at a salary not exceeding $720.00 a year. The office of such entomologist shall be in the State House, and the custodian shall select and set apart a room for the use of such entomologist and equip it with proper and necessary office furniture.

DUTIES—SAN JOSE SCALE—REPORT.

Sec. 2. The State Entomologist shall devote his entire time to the discharge of the duties of his office. He shall co-operate with any local horticultural society or individual in the State in any effort to locate, check or eradicate the San Jose Scale or any insect pest injurious to orchard or field crops or to shade and ornamental trees. He shall also assist in identifying and combating fungus or other destructive diseases to plant life. In the discharge of his duties he shall go to any part of the State where his services are requested and his duties will permit. He shall, immediately upon taking his office, prepare and cause to be published and from time to time thereafter in pamphlet form, all available information relating to San Jose Scale and other injurious plant diseases, with the methods of detecting the same and the modes of treatment. He shall send a copy of such pamphlet to each township trustee, city clerk, public school teacher, and any other citizen of the State applying for the same for the purpose of informing the people of the history, habits and methods of eradicating injurious insects and plant diseases. He shall make an annual report to the Governor of the work done by his office and with other matters contained in that report shall be a list of all townships in the State where the San Jose Scale is known to exist.

NURSERY INSPECTION.

Sec. 3. The State Entomologist shall inspect all nurseries in Indiana, where trees, shrubs, vines, plants or other nursery stock are grown and offered for sale, at least once each year, not earlier than June first nor later than October first, at such time as he may elect, and he shall notify in writing the owners of such nurseries, the Secretary of State Board of Agriculture, the Director of the State Experiment Station, and the President of the State Horticultural Society of the presence of the San Jose Scale or other injurious insects or fungi on trees, shrubs, vines plants or other stock of such nurseries, and shall notify in writing the owner of any affected stock that he is required on or before a certain date to take such measures for the destruction of such insect or fungus enemies of nursery stock as have been shown to be effectual for this purpose. The said State Entomologist is hereby empowered with the authority to enter upon any premises and examine all trees, plants, shrubs, vines and fruits whatsoever in the discharge of his duties prescribed by law.

OBSTRUCTING INSPECTION—PENALTY.

Sec. 4. Any person or persons who shall obstruct or hinder said State Entomologist in the discharge of his duties shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined not less than ten dollars nor more than twenty-five.

NURSERYMEN—DUTIES—PENALTY.

Sec. 5. The owner of any affected nursery stock shall within the times specified take such steps for the destruction of the San Jose Scale or other destructively injurious insects and fungus enemies present as will exterminate the same, and it shall be a misdemeanor to ship or deliver any such stock, punishable by a fine of twenty-five dollars for every such offense, the fine recoverable before Justice of the Peace, or by indictment of the Grand Jury, of the county in which the nursery is situated, or of that to which the stock may have been shipped.

NURSERY CERTIFICATE—PENALTY.

Sec. 6. Whenever a nurseryman, or seller of trees, shrubs, vines, plants, or other nursery stock, who is a resident of this State, shall ship or deliver any such goods, he shall send on each package so shipped or delivered a written or printed certificate stating that such stock has been examined by the State Entomologist and found to the best of his knowledge and belief to be free from San Jose Scale or other destructively injurious insects or fungus enemies. Failure to furnish such certificate or furnishing a false certificate shall render him liable to a penalty of a fine of $25.00 for each and every shipment or delivery without such certificate.

ENTOMOLOGIST—FILING OF CERTIFICATES.

Sec. 7. When the State Entomologist examines any trees, shrubs, vines, plants, or other nursery stock in this State, under the supervisions of this act, and finds such nursery stock free from San Jose Scale or other destructively injurious insects and fungus enemies, he is hereby authorized to make out and deliver in writing to the owner of such stock a certificate stating that he has inspected such stock and found the same to be free from San Jose Scale and other destructively injurious insects and fungus enemies, and he shall file such certificates with the Secretary of the State Board of Agriculture, the President of the State Horticultural Society, and the Director of the State Agricultural Experiment Station, which certificates shall at all times be subject to public inspection.

(*Acts 1909, Chapter 82, Page 189. Approved March 5, 1909.*)

STATE ENTOMOLOGIST—NURSERY SHIPMENTS INTO STATE.

Sec. 1. *Be it enacted by the General Assembly of the State of Indiana:* That section 8 of an act entitled "An act to provide for the appointment of a State Entomologist, defining his powers, prescribing his duties, fixing his compensation, providing for the inspection of nursery stock, and to prevent the dissemination of the San Jose Scale and other dangerously injurious insects and plant diseases, defining the penalties for the violation of this act, making an appropriation therefor, repealing all laws in conflict herewith, and declaring an emergency," approved March 9, 1907, be amended as follows: Every package of trees, shrubs, vines, plants or other nursery stock shipped into the State from another State or shipped within the State from one point to another shall be labeled on the outside with the name of the consignor, the name of the consignee, and a certificate signed by a State or government inspector, showing that the contents have been examined by him and that to the best of his knowledge and belief such stock is free from San Jose Scale, or other destructive insects or fungus enemies.

SHIPMENTS WITHOUT CERTIFICATES—PENALTIES.

Sec. 2. Be it enacted further that section 9 of the said act be amended to read as follows: Whenever any trees, shrubs, vines, plants or other nursery stock are shipped into or within the State without such certificate plainly fixed on the outside of the package, box or car containing the same, the fact must be reported within twenty-four hours to the State Entomologist, by the agent of the railway, express or steamboat company or other person or persons carrying or receiving the same. And any agent of any railway, express or steamboat company, or other person or persons who shall violate the provisions of this section, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not less than twenty-five dollars ($25.00) nor more than one hundred dollars ($100.00) and costs, or imprisonment in the county jail not less than five (5) nor more than thirty (30) days, or may be so fined and imprisoned in the discretion of the court, and any such fines within the provisions of this act shall be paid over to the State treasury. On notification of the receipt of such uncertified package or packages of trees, shrubs, vines or plants, the State Entomologist shall examine or cause to be examined said package or packages, at the expense of the express, railroad, or steamship companies or other person or persons carrying the same, and if found to be free from injurious insects and plant diseases he may allow them to pass to their destination, otherwise he shall cause the same to be burned and destroyed. But in no case shall the agent of the railroad or other transportation company allow said package or packages to pass out of his possession under penalty until the same has been duly inspected by the State Entomologist or his deputies.

APPROPRIATION.

Sec. 3. Be it further enacted, That section 10 of the said act be amended to read as follows:

The sum of fifteen thousand dollars annually, or so much as may be necessary thereof, is hereby appropriated out of any moneys in the State treasury not otherwise appropriated for the purpose of paying the salaries and expenses as provided for in this act. The Auditor of the State is hereby directed to honor requisitions made by the State Entomologist for salaries and all expenses when properly audited. The State Entomologist shall make an annual report to the Governor of the items and total amount expended.

STATE INSPECTOR OF APIARIES.

Sec. 4. The State Entomologist shall be and is hereby constituted State Inspector of Apiaries and as such inspector it shall be his duty to aid and assist in the development and protection of the bee and honey industry in this State, and to adopt and carry out proper measures for the prevention and suppression of contagious and infectious diseases among bees.

POWERS AS TO APIARIES.

Sec. 5. The State Entomologist shall have full power and authority at his discretion to visit and examine any apiaries for the purpose of discovering whether or not any disease may exist among bees in any part of the State. When notified of the existence or the probable existence of foul brood or other contagious or infectious diseases among bees in any apiary in the State he shall visit and examine said apiary so reported, and all other apiaries in the same neighborhood that he may be informed about by diligent inquiry or otherwise, for the purpose of determining whether such disease exists or not. Whenever he shall be satisfied of the existence of foul brood or other diseases in their malignant form in any apiary it shall be his duty to order all colonies so affected, together with all hives occupied by them, and the contents of those hives and all tainted appurtenances that cannot be disinfected and that might cause the further spread of the disease to be immediately destroyed by fire under his personal supervision and care, but where said entomologist, who shall be the sole judge thereof, shall be satisfied that the disease exists in incipient stages, and is being or may be treated successfully, and he shall have reason to believe that it may be entirely cured, then he may in his discretion omit to destroy or order the destruction of the colonies or hives in which the disease exists. Whenever the disease shall be found to exist and the treatment for the same shall be ordered by the State Entomologist, he shall give to the owner or to the person in charge of the apiary instructions as to the manner of treatment of such apiary, and to see that such treatment be carried out, and should the said owner or person in charge of said apiary refuse or fail to carry out the said instructions to the complete eradication of the disease or the satisfaction of the State Entomologist, he shall destroy or order to be destroyed all said diseased colonies by fire as provided for in case of disease in this malignant form.

TRANSFER OF BEES.

Sec. 6. The State Entomologist shall have full power in his discretion to order any owner, possessor or person having charge of bees dwelling in box hives (having mere boxes without frames) in apiaries where disease exists, to transfer such bees to movable frame hives, within a specified time, and in default of such transfer he shall order destroyed or destroy all such box hives and the bees dwelling therein.

RIGHT OF ENTRY INTO PREMISES.

Sec. 7. The said State Entomologist shall have the right to enter for the performance of his duties upon any premises where bees are kept.

ANNUAL REPORT TO THE GOVERNOR.

Sec. 8. The State Entomologist shall include in his annual report to the Governor such information in regard to the work of the apiary inspection and bee culture as he may deem of importance to the State.

DISEASED BEES OR APPLIANCES—PENALTY.

Sec. 9. Any owner of any apiary where disease exists or any person or persons, company or corporation, who shall sell, barter, or give away, or import into this State, any colony or colonies of bees or appliances infected with disease, or expose to the danger of other bees any comb, honey, bee hives or appliances infected with disease, or conceal the fact that disease exists among his or their bees when disease is known to exist, or refuses to allow the State Entomologist to inspect or treat any apiary or appliances or shall resist, hinder or impede him in any way in the discharge of his duties under the provisions of this act, shall be guilty of a misdemeanor and upon conviction shall be fined in any sum not less than $10.00 nor more than $25.00.

DUTIES TO BEEKEEPER.

Sec. 10. Every beekeeper or other person who is aware of the existence of foul brood or other infectious or contagious diseases in his own apiary or elsewhere shall immediately notify the State Entomologist of the existence of such disease, and in default of so doing shall be guilty of a misdemeanor and upon conviction shall be fined in any sum not more than $10.00.

DEFINITIONS.

Sec. 11. Apiaries within the meaning of this act shall be any place where one or more hives, swarms or colonies of bees shall be kept.

ORDERS FOR TREATMENT—AFFIDAVIT.

Sec. 12. Whenever, as the result of an official inspection, the State Entomologist or any of his deputies shall order the treatment or removal of any trees, shrubs, vines, or plants, or shall order the treatment or destruction of any bee hives, frames or other appurtenances connected with apiculture, he may require that an affidavit shall be filed by the owner or person in charge of the property so affected in which it shall be stated that the treatment ordered has been carried out to the best of the affiant's ability and that the work has been effective for the purpose prescribed. Any person making such affidavit, knowing the same to be false, shall be guilty of perjury.

DEPUTIES—SALARIES.

Sec. 13. The State Entomologist shall have the authority to employ such deputies and assistants as the work of the office may require. They shall hold office for such periods of time as the work of the office may require, and in their appointment the State Entomologist shall consider only their fitness for the work which they will undertake, disregarding entirely all political affiliations. The salary of no deputy shall exceed twelve hundred dollars ($1,200.00) per annum. The Inspector of Apiaries shall receive for his services the sum of one thousand dollars ($1,000.00) per annum in addition to his salary as State Entomologist. Such compensation to be paid out of the general appropriation for this act.

EMERGENCY.

Sec. 14. Whereas an emergency exists for the immediate taking effect of this act it shall be in full force and effect from and after its passage.

(*Acts of 1915, Chap. 83, Page 200.*)

STATE ENTOMOLOGIST—TREES AND SHRUBS—CERTIFICATE OF EXAMINATION.

Section 1. *Be it enacted by the General Assembly of the State of Indiana,* That section 6, of the first above entitled act, be amended as follows: Section 6. Whenever a nurseryman, seller of trees, shrubs, vines, plants or other nursery stock, or any other person who is a resident of this State shall ship or deliver any such goods, he shall attach to each package so shipped, or delivered, a written, or printed certificate stating that such stock has been examined by the State Entomologist and found to be to the best of this knowledge and belief to be free from San

Jose scale or other injurious or destructive insects or fungous enemies. Said certificate shall become invalid on the first day of June following the date of its issue. Failure to attach to each package of nursery stock so shipped or delivered, such certificate, or to furnish a false certificate, or the use of an invalid certificate, shall be deemed a misdemeanor and any person upon conviction thereof shall be fined as is provided in section 9, of this act. Persons desiring to sell or ship nursery stock shall make application in writing before July 1st of each year to the State Entomologist for an inspection of their stock. Persons failing to comply with this provision shall be liable for extra charges to cover the traveling expenses of the inspector. Every person receiving directly or indirectly any nursery stock from foreign countries shall notify the State Entomologist of the arrival of such shipment and the contents thereof, name of the consignor, and shall hold such shipment unopened until duly inspected or released by the State Entomologist. In case any infested or infected stock is discovered, the shipment shall be subject to destruction or treatment according to the directions of the State Entomologist.

DEALERS' LICENSE.

Sec. 2. All dealers within the meaning of this act located either within or without the State, engaged in selling or soliciting orders for nursery stock in this State, shall secure a dealer's license by furnishing a sworn affidavit that he will buy and sell only stock that has been duly inspected and certified by an official inspector and that he will maintain with the State Entomologist a list of all sources from which he secures his stock. The term "dealer" shall be construed to apply to any person, whether he be a grower of nursery stock or not, who buys nursery stock for the purpose of reselling or reshipping.

AGENTS' LICENSE.

Sec. 3. All agents within the meaning of this act selling nursery stock for any nurseryman or dealer located within the State or outside the State shall be required to secure and carry an agent's license bearing a copy of the certificate held by the principal. Said agent's license shall be issued only by the State Entomologist and to agents authorized by their principal or upon the request of the principal. The term "agent" shall be construed and applied to any person selling nursery stock under the partial or full control of a nurseryman or of a dealer or other agents. This term shall also apply to any persons engaged with a nurseryman, dealer or agent, in handling nursery stock on a co-operative basis.

LICENSES TO FIRMS OUTSIDE THE STATE.

Sec. 4. Nurserymen, dealers, agents, or other persons whose place of business is outside the State, desiring to sell or solicit orders for nursery stock in this State, may upon the filing of a certified copy of his original State certificate with the State Entomologist of this State obtain a license permitting such persons to sell or solicit for nursery stock in this State.

MISREPRESENTATION OF STOCK.

Sec. 5. It shall be unlawful for any persons to wilfully misrepresent to any other person the grade, character, variety or quality of stock in a nursery or stock offered for sale by any nurseryman, dealer or agent, or to cause any concealment of stock from inspection, or to withhold any information requested by the State Entomologist for the purpose of preventing the proper enforcement of this act. Each person selling or soliciting orders for nursery stock in this State, shall, if requested, furnish the State Entomologist with copies of his order forms, contracts and agreements with his customers, which are furnished for the use of agents or customers or both.

CERTIFICATE REVOKED.

Sec. 6. The State Entomologist shall at any time have the power to revoke any certificates or licenses for sufficient cause, including any violation of section 5 of this act, or non-conformity with any rule or regulation promulgated under this act.

LICENSE FEE.

Sec. 7. A fee of $1.00 shall be collected by the State Entomologist for each dealer's and agent's license issued either to parties or firms within the State or outside the State, said fees to be deposited monthly with the State Treasurer and become a fund to aid in defraying the expenses incidental to regulating dealers and agents and inspecting nursery stock received by them, prior to or subsequent to its delivery.

TREATMENT OF TREES AND BEE HIVES.

Sec. 8. *Be it enacted further*, That section 12 of the second above entitled act, approved March 5, 1909, be amended as follows: Section 12. Whenever, as the result of an official inspection, the State Entomologist or any of his deputies shall order the treatment or removal of any trees, vines, shrubs or plants, or shall order the treatment or destruction of any bee hives, frames, or other appurtenances connected with apiculture, he may require that an affidavit shall be filed by the owner or person in charge of the property so affected, in which it shall be stated that the treatment ordered has been carried out to the best of the affiant's ability, and that the work has been effective for the purpose prescribed. The State Entomologist is hereby empowered to prevent the removal or transportation from any private or public place or any area of the State which contains dangerously infected plant material of any kind, and also bees or bee appliances infected with disease, for such periods and under such conditions as is in his judgment necessary in order to prevent the further spread of the infestation or infection, giving such notice thereof either personally, by deputy, or by letter; and during the existence of such order no person shall remove or ship from this area any such plant material, bees or bee appliances as are set forth in the order, except by special permit issued by the State Entomologist. In case the owner or person in charge of any infected or infested premises or apiary shall refuse or neglect to carry out the order issued by the State Entomologist within the period of time allowed for the performance of the work, the State Entomologist may proceed to destroy or treat the infested or infected plants or plant material, colonies of bees or bee appliances. The expense thereof shall be certified by the State Entomologist to the county auditor of the county wherein such infested or infected premises, or apiary is situated, and such county auditor shall place the amount so certified upon the tax duplicate, and such amounts shall be collected at the same time and in the same manner that the State and county taxes are collected. The amount of such expense when collected shall be paid to the State Treasurer by the county treasurer of such county at the time when and in the manner in which he makes his next succeeding semi-annual settlement with the State Treasurer. All amounts so collected and paid into the State Treasury shall become a part of the fund used to enforce the provisions of section 8 of this act.

PENALTY.

Sec. 9. Any person violating any section of this act or any rules or regulations promulgated under this act, shall be guilty of a misdemeanor and on conviction thereof shall be fined in the sum of not less than $10.00 nor more than $100.00 for each offense. It shall be the duty of each prosecuting attorney to whom the State Entomologist or any of his deputies shall present satisfactory evidence of violation of any provisions of this act to prosecute without delay such violations in the proper court.

ACT EFFECTIVE.

Sec. 10. This act shall take effect and be in full force from and after June 1, 1915.

(*Acts 1915, Chap. 135, Page* 557.)

An act concerning the organization of horticultural and quarantine districts and their administration by voluntary associations.

(H. 363. Approved March 9, 1915.)

CORPORATION—HORTICULTURE—DISEASES AMONG TREES.

Section 1. *Be it enacted by the General Assembly of the State of Indiana*: That horticultural and quarantine districts, to be administered by voluntary associations and their duly elected officers, may be organized, under the provisions of this act, for any or all of the following purposes:

First. To prevent the spread of contagious diseases among fruit, fruit trees and fruit-bearing plants;

Second. To provide for the prevention, treatment, cure and extirpation of fruit pests and diseases of fruit, fruit trees and fruit-bearing plants;

Third. To provide for the purchase and maintenance of spraying machines, wagons or other necessary apparatus to adequately spray fruit trees or other fruit-bearing plants and to hire men and teams to perform the required labor, and to incur the necessary expense to carry out the purposes of this act;

Fourth. To hire experts to inspect the fruit trees and fruit-bearing plants found within such horticultural and quarantine district and to prescribe the proper methods of treatment of any diseases of such trees or plants which may be found to exist.

ARTICLES OF ASSOCIATION.

Sec. 2. That any number of persons, not less than ten (10) who may be the owners of the land constituting any contiguous area, upon which lands are situated orchards or fruit trees or other fruit-bearing plants, may voluntarily associate themselves together for the purpose of organizing a horticultural and quarantine district. The articles of association shall be in writing and shall be signed and acknowledged by each person who desires to become a member of such organization. The articles of association shall specify:

First. The corporate name of such association;

Second. The objects of such association, generally;

Third. The name and residence of each incorporating member;

Fourth. The term of existence of such association, which in no case shall exceed ten (10) years;

Fifth. The number of directors who shall manage the affairs of the association.

Such association shall have no capital stock. The articles of association may be amended at any time such action may be deemed advisable, by supplementary and amended articles, signed and acknowledged by a majority of the members of the association at the time of such amendment, and recorded in the same manner as the original article.

ELECTIONS OF DIRECTORS.

Sec. 3. Three (3) or more members of the association may give notice that at a time specified, and at a convenient place named within or near the proposed horticultural and quarantine district, an election will be held for the purpose of choosing directors of the association to administer the affairs of the horticultural and quarantine district. The notice may be published in one newspaper in the county and of general circulation among the members of the association or such notice may be delivered in person.

TERM OF OFFICE.

Sec. 4. On the day and hour and at the place specified in the notices, and if a majority of the members of the association shall be present, such members shall proceed to elect by ballot, three (3) of their number as directors of the association, and such directors shall determine by lot immediately the terms of their office, which shall be respectively, one, two and three years, and they shall serve until their successors are elected and qualified. Annually thereafter, the directors shall call a meeting of the members of the association, in the manner provided in section three (3) of this act, and such members shall meet at the time and place fixed by the directors and elect one director who shall hold his office for a term of three (3) years.

FILLING VACANCY.

Sec. 5. If a vacancy occurs in the office of directors the remaining directors shall fill the vacancy by a pro tem. appointment from among the members of the association, which appointment shall continue until the next annual election.

ARTICLES FILED.

Sec. 6. The association shall, either before or after the election of directors, cause their articles of association to be filed in the office of the Secretary of State and shall also cause to be recorded in the recorder's office of each county in which any part of the proposed horticultural and quarantine district may be situated a duplicate copy of such articles of association and thereafter such association shall be a body politic and corporate by the name and style so adopted, and shall have and possess all the rights, powers and privileges given to corporations, to sue and be sued, plead and be pleaded, answer and be answered in any court of competent jurisdiction, borrow money and levy assessments upon the owners of the lands, orchards and trees and other fruit-bearing plants situated therein, as hereinafter provided and to rent, lease, purchase, hold, sell and convey such personal property as may be necessary and proper for the purposes and objects of the corporation. A majority of the members of such association shall have the power to adopt by-laws for the government of such horticultural and quarantine district and make such rules as may be necessary to carry the same into force and effect.

BOUNDARY OF QUARANTINE DISTRICT.

Sec. 7. The boundary of such horticultural and quarantine district shall coincide with a line inclosing the lands owned by the members of the association. Any person who is the owner of lands contiguous to such horticultural and quarantine district shall be entitled at any time to become a member of the association by signing the articles of association. Horticultural and quarantine districts may be increased in size progressively by the annexation of contiguous territory in the manner prescribed in this section, but no such horticultural or quarantine district shall contain in excess of twenty (20) square miles of territory. Contiguous horticultural and quarantine districts may be consolidated if the combined area of the consolidating districts does not exceed twenty (20) square miles. The question of consolidation may be submitted to the members of the respective associations at a joint meeting called for that purpose and if a majority of those entitled to vote shall be in favor of such consolidation, a new district comprising such districts so consolidated shall be formed and the proper papers and documents shall be filed as prescribed in section six (6) of this act. Directors of the new district may be chosen at the meeting called to determine the question of consolidation or at any subsequent meeting.

MEMBERS ENTITLED TO VOTE.

Sec. 8. All persons who have signed the articles of association and have paid the assessments levied against them from time to time shall be entitled to vote at any meeting of the members of the association on any and all questions which may lawfully come before such association and each member shall be entitled to one vote on any and all questions.

OFFICERS—DUTIES.

Sec. 9. The directors shall elect one of their number president and one secretary. The secretary shall likewise be treasurer of the association and shall have the custody of all the money of the association. He shall be required to execute a bond with good freehold surety for double the amount of money which will probably come into his hands at any time during his term of office. The secretary shall keep a record of the transactions of the association, including brief minutes of all meetings, the results of the various elections, an itemized account of all receipts and expenditures, and such secretary shall present a report of all such transactions to the members of the association at their annual meeting.

WARRANTS.

Sec. 10. No money shall be drawn from the treasury of such association except upon the order of a majority of the board of directors and all warrants drawn shall be signed by the president of the board of directors and attested by the treasurer.

MEETINGS CALLED.

Sec. 11. A majority of the board of directors, or any five (5) members of the association, may call a special meeting of the members of the association at any time. A majority of the members shall constitute a quorum to transact ordinary business not required by law to be transacted at the regular meeting prescribed by law.

PURPOSES OF CORPORATION.

Sec. 12. The board of directors of any association shall administer the affairs of such association under the provision of this act, for any or all of the following purposes:

First. To prevent the spread of contagious diseases among fruit, fruit trees, and fruit-bearing plants;

Second. To provide for the prevention, treatment, cure and extirpation of fruit pests and diseases of fruit and fruit-bearing plants;

Third. To provide for the purchase and maintenance of spraying machines, wagons, or other necessary apparatus, to adequately spray fruit trees or other fruit-bearing plants, and to hire men and teams to perform the required labor, and to incur the necessary expense to carry out the purposes of this act;

Fourth. To hire experts to inspect fruit trees and fruit-bearing plants found within such horticultural and quarantine district and to prescribe the proper methods of treatment of any diseases of such trees or plants which may be found to exist;

Fifth. To levy such assessments on the members from time to time as may carry out the provisions of this act and the purposes of such association;

Sixth. To actively co-operate with the State Entomologist and the county agents in precautionary measures to prevent the spread of injurious insects and plant diseases within the district;

Seventh. To advise, direct and encourage the activities of the association.

The board of directors of any association may hire experts to inspect fruit trees and fruit-bearing plants, and to prescribe the proper methods of treatment of any diseases of such trees or plants which may be found to exist, if directed to do so by the majority of vote of the members taken at any special or regular meeting.

STATE ENTOMOLOGIST—CO-OPERATION.

Sec. 13. The State Entomologist shall co-operate with any horticultural or quarantine association in the State in any efforts to prevent, locate, check, or eradicate any injurious insects or fruit disease. He shall from time to time, or upon request, send all available information relating to injurious insects and plant diseases with the methods of detecting the same and the modes of treatment, to the board of directors of any horticultural or quarantine association.

COUNTY AGENTS EX-OFFICIO DEPUTY.

Sec. 14. In counties having a county agent, the county agent shall be ex-officio deputy state entomologist for such county; he shall be authorized and required to carry out the instructions of the State Entomologist; and shall under the direction of the State Entomologist, co-operate with any local horticultural association or society in any effort to prevent, locate, check, or eradicate any injurious insects or fruit diseases. He shall receive no additional compensation for the performance of such duties.

MEMBERS ASSESSED.

Sec. 15. For the purpose of raising money necessary to meet the expenses of horticultural and quarantine associations, the board of directors shall assess the individual members of the association in proportion to the service derived, procured, or otherwise obtained from such association, on the basis of the acreage, or number of trees, plants, vines, or other herbaceous plants in such equitable proportions as such aforesaid directors may deem just.

EMERGENCY.

Sec. 16. Whereas, an emergency exists for the immediate taking effect of this act, the same is hereby declared to be in force from and after its passage.

UNITED STATES.—All persons who intend to import trees or plants from any foreign country should first apply for and receive a permit from the Federal Horticultural Board, United States Department of Agriculture, Washington, D. C., under the Plant Quarantine Act of August 20, 1912.

A permit should be applied for in advance. This permit should preferably be taken out by the person who is to receive the goods at the final destination. A broker or commission merchant may take out a permit in his own name, if he imports for his own account, or he may act as agent for and take out the permit in the name of the actual purchaser. The importer must see that each package on arrival at the port of entry bears the proper certificate of foreign inspection. He must also see that each package is marked in accordance with Section 3 of the act. As a matter of convenience, this marking should contain also the additional information called for in Section 4, to avoid the trouble of re-marking before the goods can be delivered, for interstate shipment. The certificate of inspection must be, and the marking preferably should be on the goods before they leave the foreign port.

On the arrival of the stock, and before shipping or removing it from the port of entry, he must advise the Secretary of Agriculture and the proper State inspectors in accordance with Section 2 and Regulation 8. He must see that each container is marked in accordance with Section 4; that is, in addition to the information in the label of entry, each container must bear the name and address of the consignee at destination, where the stock is to be inspected by the state, territorial or district official.

Any person receiving imported nursery stock and reshipping it, interstate, before it has been inspected by a duly authorized state, territorial or district inspector or officer, is required, prior to making such reshipment, to notify the Secretary of Agriculture and the duly authorized inspector or other officer of the state, territory or district, to which the nursery stock is to be reshipped, giving the number of cases, the bale numbers and marks, the quantity and kind of nursery stock, and the name and address of the consignee. If possible, the permit number under which the stock was imported, and the name and address of the foreign shipper should also be given.

Failure to meet the requirements of the law, as outlined above, subjects importers or persons making interstate shipments to the penalties fixed in Section 10 of the act.

A pamphlet entitled, "Rules and Regulations Under the Plant Quarantine Act: General, Including Nursery Stock," containing the regulations governing the importation of nursery stock into the United States and the text of the Plant Quarantine Act of August 20, 1912, as amended March 4, 1913, may be obtained on application to the *United States Department of Agriculture, Federal Horticultural Board, Washington, D. C.*

NURSERY STOCK BY MAIL.

The following is a copy of order 6313 of Postmaster-General, dated May 29, 1912, amending paragraph 8, section 496 of postal laws and regulations, to read as follows:

Nursery stock, including florists' stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, bulbs and roots (which may carry injurious insects), may be admitted to the mails only when accompanied by a certificate from a state or government inspector to the effect that the nursery from which said nursery stock is shipped has within a year been inspected and found free from injurious insects.

TREATMENT TO BE ACCORDED TO PROHIBITED NURSERY STOCK RECEIVED IN THE MAILS FROM FOREIGN COUNTRIES.

Office of Second Assistant Postmaster-General,
Washington, June 1, 1915.

This department and the Department of Agriculture are in receipt, frequently, both directly and through postmasters, of requests from importers of nursery stock that delivery be authorized of certain mail shipments of prohibited plants or plant products. It is understood that pending the receipt by such importers of replies to their requests, the shipments in question are withheld from return by postmasters, notwithstanding the instructions of the department that all packages of prohibited nursery stock received in the mails from abroad shall be appropriately indorsed and returned to origin immediately.

Postmasters are enjoined, therefore, to comply strictly with the instructions referred to by declining to withhold from return any prohibited nursery stock in order to afford an opportunity to the importer to communicate with the Department with the view of having an exception made in any particular case.

The term "nursery stock," as applied to the prohibition in question, includes all growing or living plants, seeds and other plant products, for propagation except field, vegetable and flower seeds. It includes also bulbs, roots and tubers and, with the exceptions noted, the seeds of all trees, shrubs or other plants. The only plants or plant products excepted from the prohibition are those ordered by, or intended for, and addressed to the "Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, D. C."

In this connection, reference is had to the notice of this office printed on page 2 of the Postal Guide (supplement) for January, 1914, and to the notice on pages 129 and 130 of the Postal Guide for July, 1914.

The widest possible publicity should be given to this notice.

JOSEPH STEWART,
Second Assistant Postmaster-General.

ALABAMA.—A signed copy of inspection certificate must be filed with the secretary of the Alamaba State Board of Horticulture, and an Alabama license obtained, also Alabama tags. Nursery and dealers' license fee, $10.00. Agents must obtain license through their principal. License fee for agents, $1.00. Dealers must designate duly licensed nurseries from whom stock handled is purchased. A tag must be attached to every separate order or lot of nursery stock delivered in the State. Tags are furnished at cost: first one hundred, 65 cents postpaid; five hundred, $1.60; one thousand $2.20, sent collect by express.

Nursery stock must be free from the following insects and fungous diseases: San Jose scale, new peach scale, woolly aphis, crown gall, black knot, peach yellows, peach and plum rosette, citrus canker, white fly, gypsy moth and browntail moth. Trees liable to scale infection must be properly fumigated with hydrocyanic acid gas.

All kinds of citrus trees are under quarantine. Nurseries in the state free from citrus canker may obtain license for citrus stock upon obtaining special citrus permit, and upon compliance with the special rules covering shipments of such trees and other hosts of white fly, or citrus canker, which is, that such trees be completely defoliated.

Special citrus permit tags are supplied at $1.00 a hundred; 50 cents a hundred for additional lots. These must be used in addition to regular tags on all shipments containing citrus trees. —Prof. Ernest Walker, State Horticulturist, Auburn, Ala.

ARIZONA.—Nursery stock shipped into the State must be prominently labeled with the name and address of both the shipper and the consignee, and must be accompanied by a valid certificate of inspection or a copy of such certificate. Shipments into the State, consisting of or containing plants not grown in the locality from which shipment was made must, in addition, specify where such plants were grown. State quarantine orders of interest to nurserymen prohibit: (No. 1) the importation of stock from sections infested by the alfalfa weevil; (No. 3) rooted grape vines from north of the north line of San Bernardino, Kern and San Luis Obispo counties, California; (No. 8) the importation of citrus nursery stock from all other states and territories and of cape jessamine, privets and rubber plants from North Carolina, South Carolina, Georgia, all states bordering on the Gulf of Mexico and Yuba County, California. Other quarantines relate to the Mexican orange maggot (quarantine made practically inoperative owing to establishment of Federal quarantine), cotton boll weevil, date palm scales and citrus canker. None of these latter concern shipments of nursery stock. All shipments of living plants into the State of Arizona are inspected by Arizona State inspectors and not delivered until a certificate of release is issued in each case, to the common carrier and to the consignee. If trees or plants are infested or infected with insect pests or plant diseases of general occurrence in the section of the State where the shipment is received, treatment to eradicate, or the separation of the infested or diseased plants or trees, is in most cases permissible; otherwise all plants or trees of the kind found to be infested or diseased are held in quarantine and are shipped from the State or destroyed at the owner's option. Copies of quarantine orders furnished upon application.—A. W. Morrill, State Entomologist, Phoenix, Arizona.

ARKANSAS.—Shipments of nursery stock into the State must be accompanied by a copy of the valid certificate of inspection. Carriers bringing into the State shipments of nursery stock which originated in foreign countries or foreign possessions of the United States must notify the State Entomologist in writing and must hold such stock at any place designated by him until the same has been duly inspected and released.—Geo. G. Becker, State Entomologist, Fayetteville, Ark.

CALIFORNIA.—Shipments of nursery stock into California are held by transportation companies until inspected by the State officials. All packages must be marked with the name and address of the shipper, name of the consignor and the name of the place where the stock was grown. Peach, apricot and almond trees from districts where yellows and rosette are known to exist shall be refused entry and shall be destroyed or returned to the shipper. Notice of shipment of nursery stock to California should be sent to the following address, and also to the Quarantine Guardians at the point of destination.—Frederick Maskew, Chief Deputy, Quarantine Office, Room 11, Ferry Bldg., San Francisco, California.

CANADA.—No nursery stock shall be imported that is infested with any of the following insect pests or diseases: San Jose scale, browntail moth, gypsy moth, woolly aphis, West Indian peach scale, potato canker, gooseberry mildew, internal and external parasitic diseases of potato, branch canker, blister rust of white pine, Mediterranean fruit fly, potato tuber moth. Nursery stock shall be imported only through the ports and during the periods mentioned: Vancouver, B. C., from October 1 to May 1; Niagara Falls, Ont., from October 1 to May 15; Winnipeg, Man., North Portal, Sask., and St. John, N. B., from March 15 to May 15, and from October 7 to December 7; Windsor, Ont., and St. Johns, Que., from March 15 to May 15, and from September 26 to December 7. Importations by mail are prohibited. The port by which it is intended that the nursery stock shall enter shall be clearly stated on each package, and notice of shipment must be sent to the Dominion Entomologist, Ottawa. European nursery stock and certain other classes of vegetation may in the case of certain ports be allowed to proceed and shall be inspected at point of destination, but must not be unpacked except in the presence of the inspector. Copies of the regulations governing the importation of nursery stock into Canada may be obtained from Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa, Canada, to whom all inquiries should be addressed.

COLORADO.—The State Entomologist has general supervision of the inspection of nurseries and orchards to prevent the introduction and spread of injurious insects and plant diseases. County horticultural inspectors do their work under the direction of the State Entomologist in the fruit-growing counties of the

State. They are appointed by the county commissioners, after passing an examination under the State Entomologist, showing their qualifications for the work.

All nursery stock coming into the State must bear certificates of inspection and fumigation, and on arrival in counties having inspectors, is turned over to them and released by them to consignee, if the stock passes inspection.—C. P. Gillette, State Entomologist, Fort Collins, Colorado.

CONNECTICUT.—All nursery stock shipped into this State shall bear on each package a certificate that the contents of said package have been inspected by a State or government officer and that said contents appear free from all dangerous insects and diseases. If nursery stock is brought into the State without such a certificate, the express, freight, or other transportation company or person shall, before delivering shipment to consignee, notify the State Entomologist of the facts, giving name and address of consignee, origin of shipment, and approximate number of cars, boxes, or packages, and probable date of the delivery to the consignee. The State Entomologist may cause the inspection and if infested the treatment of the stock. No person, firm, or corporation shall unpack any woody field-grown nursery or florists' stock brought into this State from foreign countries except in the presence of an inspector, unless given permission to do so by said State Entomologist or one of his deputies. If such stock is found infested with any dangerous pests the State Entomologist may at his discretion order it treated. Any person violating any of the provisions of this act shall be fined not more than $50.—Dr. W. E. Britton, State Entomologist, New Haven, Conn.

DELAWARE.—Shipments of nursery stock into the State must bear a certificate of inspection and also a certificate stating that the stock has been properly fumigated. All nursery stock not accompanied by proper certificates may be held by the transportation companies until it can be inspected.—Wesley Webb, Secretary, State Board of Agriculture, Dover, Del.

FLORIDA.—All shipments of articles or things specified in this act, into the State of Florida, from the states and territories and possessions of the United States, except as otherwise prohibited, shall be defoliated and fumigated as provided in Rules 3 and 4 hereof, and shall have securely and conspicuously attached to each and every package a permit-certificate. This permit-certificate shall be issued, free of charge, by the Inspector of Nursery Stock of the State of Florida in exchange for an approved certificate issued by the proper government or state official at the point of shipment. Printed copies, on tags, of this permit-certificate, to be used when making shipments, must be obtained from the Inspector of Nursery Stock, and an order for such tags, with cash for the amount, must accompany all requests for such permit-certificates.

That in order to prevent the introduction of the new citrus disease known as Citrus Canker, prevalent in the principal citrus-growing sections of the Gulf States, but not widely prevalent in Florida, the importation into Florida from all the States of the United States, its territories and possessions, and all foreign countries, of any and all kinds of citrus trees and parts thereof, including bud wood and graft wood, and all other host plants of this disease as soon as any are discovered, except fruit intended for eating, and seeds, is hereby prohibited.

Provided, That importations of limited quantities of new or rare varieties may be allowed by special permit of the Board of Control. Applications for such permits must be made to the Inspector of Nursery Stock.

Provided further, That this prohibition does not apply to shipments made by the United States Department of Agriculture. —F. M. O'Byrne, Inspector of Nursery Stock, Gainesville, Florida.

GEORGIA.—Nurseries are inspected annually. A signed duplicate of inspection certificate, together with a statement by the nurserymen that all stock intended for Georgia will be fumigated in accordance with directions furnished them, must be filed in the office of the State Entomologist. Official tags of the Georgia State Board of Entomology will be furnished through the State Entomologist at the following prices: One hundred tags, 60 cents, postpaid; 200 tags, 85 cents, postpaid; 300 tags, $1.10, postpaid; 500 tags, $1.35, sent by express, collect; 1,000 tags, $2, sent by express, collect. Each shipment of nursery stock into the State of Georgia must bear the official tag of the Georgia State Board of Entomology, and also a duplicate certificate of inspection of the State from which the shipment is made.—Prof. E. L. Worsham, State Entomologist, Atlanta, Ga.

IDAHO.—No person, firm or corporation shall import or sell nursery stock without first applying to the State Board of Horticultural Inspection and filing a bond in the sum of $5,000 and securing annual license upon payment of $10.00. Shipments into the State should bear a copy of an official certificate of fumigation emanating from the place where the stock was grown. All shipments into the State must bear a label showing the name of the shipper, the locality where grown and variety of nursery stock. All nursery stock, fruit trees or horticultural plants sold or delivered by principal or agents shall be true to name and variety as represented. All nursery stock shipped into this State, whether bearing certificate of inspection or not, must be inspected again upon its arrival, the consignee paying for such inspection. Every nursery firm doing business in this State must pay annually $1.00 additional for each agent who represents them.—Guy Graham, State Horticultural Inspector, Boise, Idaho.

ILLINOIS.—State nurseries are inspected and certified not later than October 1. An inspection certificate shall be valid for one year from date of inspection. The State Entomologist is authorized to revoke a certificate if he finds it is being used in violation of the law. He is also required to furnish all Illinois nurserymen with a list of State and government inspectors whose certificates may be received as equivalent to his own, and the nurseryman receiving stock under such certificates is authorized to substitute for them the Illinois certificate of inspection. Each dealer in nursery stock who has no nursery of his own and each agent for a nursery located outside of Illinois is required to furnish to the State Entomologist annually a sworn statement showing that the stock in which he deals has been duly inspected, and to submit for approval a copy of the certificate of inspection, and to attach a copy of such certificate, if approved, to every parcel of nursery stock delivered. Nursery stock shipped into the State must bear a certificate of inspection attached to each car, box, bale, bundle or package.—Dr. S. A. Forbes, State Entomologist; P. A. Glenn, Chief Inspector, Urbana, Ill.

IOWA.—State nurseries are inspected at owner's request or if supposed to be infested with dangerous injurious insects or plant diseases, and nurserymen are prohibited from selling or shipping without inspection. Shipments into the State must be accompanied by a certificate of apparent freedom from injurious insects or plant diseases. A copy of inspection certificate must be filed with and approved by the State Entomologist.—Prof. H. E. Summers, State Entomologist, Ames, Iowa.

KANSAS.—Nurseries are inspected annually between June 15 and November 1. Certificates are valid until the first day of the following June. No nursery stock shall be brought into the State nor offered for sale within the State without having been properly inspected as shown by an accompanying certificate.—State Entomological Commission, Topeka, Kans. Prof. Geo. A. Dean, Entomologist, Manhattan, Kan. Prof. S. J. Hunter, Entomologist, Lawrence, Kan.

KENTUCKY.—Nurseries are inspected annually. Every package of nursery stock shipped into the State must have a copy of a certificate of inspection attached and bear on the label a list of the contents. Duplicate certificates of inspection may be filed with the State Entomologist.—Prof. H. Garman, State Entomologist, Lexington, Ky.

LOUISIANA.—Nursery inspection is under the control of the State Board of Agriculture and Immigration. The entomologist of the experiment station has charge of the work, so all communications concerning nursery inspection should be addressed to him.

The regulations of the Board require every box, bundle, bale or package of nursery stock shipped into the State to be plainly labeled with a copy of a valid certificate of inspection showing where plants were grown, and nurserymen shipping stock into this State must first file a copy of their certificate with the inspector. Citrus trees must be defoliated.—E. S. Tucker, Entomologist, State Board of Agriculture and Immigration, Baton Rouge, La.

MAINE.—All nursery stock shipped into the State shall bear on each box or package a certificate that the contents have been inspected. The State Horticulturist has power to inspect at point of destination all stock entering the State. No person, excepting growers, shall carry on the business of selling nursery stock or soliciting purchases without first obtaining a license. The license fee shall be $5.00 per annum. The license shall be issued in the name of the dealer, salesman or agent as the case may be.—A. K. Gardner, Horticulturist, Department of Agriculture, Augusta, Me.

MARYLAND.—Nurseries are inspected at least once in six months. All nursery stock subject to attack of insect pests must be fumigated. Shipments into the State must be labeled with the name of consignor and consignee, and each package bear a certificate of inspection. Duplicate certificates should be filed with the State Entomologist.—Dr. T. B. Symons, State Entomologist; Prof. J. B. S. Norton, State Pathologist, College Park, Maryland.

MASSACHUSETTS.—Nurseries in the State are inspected annually. Agents or other persons, excepting growers, who desire to sell nursery stock in the State shall make application to and receive from the State Nursery Inspector an agent's license, and shall file with the State Nursery Inspector names and addresses of all persons or nurseries from whom they purchase stock. It shall be unlawful for any person, firm or corporation to sell, deliver or ship within the State any nursery stock unless such person, firm or corporation holds a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package delivered or shipped.

The State Nursery Inspector shall have power to inspect at its point of destination all nursery stock coming into the State, and should such stock be found to be infested with injurious insects or plant diseases he may cause it to be destroyed, or treated or returned to the consignor at the consignor's expense.—Dr. H. T. Fernald, State Nursery Inspector, Amherst, Mass.

MICHIGAN.—Nurseries are subject to inspection; infested trees must be destroyed and the remainder of the stock within a half mile must be fumigated. Shipments into the State must bear on every package, plainly labeled, the name of the consignor and consignee, statement of contents and a certificate showing that the contents have been inspected by a State or government officer, and if of species subject to the attack of San Jose scale must be fumigated with hydrocyanic acid gas. Certificates of fumigation must also be attached, together with a copy of the certificate of inspection. This applies to individual orders when several are contained in the same shipment. All nurserymen, whether residents of Michigan or other states, who wish to grow or sell stock within the State, must apply to the State Inspector of Nurseries on or before August 1 of each year for a license for which the fee is $5.00. A bond for $1,000 must also be filed. Certificates of inspection must be filed with the State Inspector of Nurseries before any stock is shipped into the State.—Prof. L. R. Taft, State Inspector of Nurseries and Orchards East Lansing, Mich.

MINNESOTA.—Inspection, annual, compulsory; inspection may be oftener if it seems desirable. Shipments into the State or within the State must be accompanied with copy of the certificate of inspection. Carrying companies accepting stock not tagged are responsible and liable to prosecution. Nurserymen in other States shipping stock into Minnesota must file with the Minnesota State Entomologist copies of their State certificates.—Prof. F. L. Wasburn, State Entomologist, St. Anthony Park, Minn.

MISSISSIPPI.—Every nursery in the State must be inspected before November 1st of each year, and every bundle, bale or package of stock sold or transported must be accompanied by a copy of the certificate of inspection attached in a conspicuous place. Every person or firm from other States wishing to ship nursery stock into Mississippi must file with the entomologist a copy of their certificate, which shall state that the nursery is properly equipped for fumigating all nursery stock. A copy of the certificate shall be attached to every bundle, bale or package of nursery stock delivered within the State. Every nurseryman must state that all nursery stock shipped into this State will be fumigated with hydrocyanic acid gas.—R. W. Harned, Entomologist, Agricultural College, Miss.

MISSOURI.—Nurseries are inspected annually. Each nursery outside of Missouri shipping stock into Missouri must apply at the office of the Chief Inspector for a permit which will be issued upon filing the necessary papers and copy of their nursery inspection certificate. No fee is charged for the permit. All agents or salesmen for nurseries must apply for an agent's permit. Every package of nursery stock shipped into the State must be clearly labeled with the name of the consignor, consignee, statement of contents and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. The transportation companies are not permitted to deliver nursery stock unless so labeled.—Leonard Haseman, Entomologist and Chief Inspector, University of Missouri, Columbia, Mo.

MONTANA.—All stock brought into the State must be unpacked, inspected and fumigated if necessary at one of the designated quarantine stations, viz.: Glendive, Miles City, Billings, Bozeman, Lewistown, Helena, Great Falls, Missoula, Victor, Como, Darby, Plains, Mondak, Glasgow, Havre, Kalispell and Eureka. Nursery stock may be inspected and fumigated at other points of delivery on payment of all costs. All correspondence and notice of shipment, including an invoice of stock, must be sent to M. L. Dean, State Horticulturist, Missoula, Mont.

NEBRASKA.—All nursery stock shipped into the State shall be labeled with the names of the consignor and consignee and a certificate showing inspection since July first preceding.—Prof. Lawrence Bruner, State Entomologist, or Prof. Myron H. Swenk, Assistant State Entomologist, Univeristy of Nebraska, Lincoln, Neb., Leroy M. Gates, Field Entomologist, Lincoln, Neb.

NEVADA.—Nursery stock shipped from other States shall bear on the outside of each car, bale or package a label giving the names of the consignor and consignee, together with a copy of an inspection certificate of recent date. Such certificate of inspection must bear the signature of a qualified person in authority in the State in which such nursery stock was grown. No transportation company shall deliver any nursery stock lacking such official certificate of inspection.—S. B. Doten, Director, Experiment Station, Reno, Nev.

NEW HAMPSHIRE.—Nurseries are inspected at least once each year. Shipments into the State must be accompanied by a certificate of inspection or, in lieu thereof, an affidavit showing that the stock has been fumigated with hydrocyanic acid gas, using not less than 2-10ths of 1 gram of cyanide of potassium per cubic foot of space, in an air-tight compartment for not less than forty minutes. A copy of the certificate of inspection or a copy of the affidavit must be attached to each car, box or package shipped into the State.—W. C. O'Kane, Acting State Nursery Inspector, Durham, N. H.

NEW JERSEY.—The State law requires the inspection of all nurseries at least once in each year. Shipments into the State must be accompanied by a certificate of inspection, or copy thereof, attached to each car or parcel, together with a statement from the shipper that the stock therein is a part of the stock inspected, and stating whether such stock has been fumigated with hydrocyanic acid gas or not. It shall be the duty of all carriers to refuse for transportation within the State all stock not accompanied by a certificate of inspection.

All stock coming into the State may be detained for examination, wherever found, by the State Entomologist or the State

Plant Pathologist, and if found to be infested with any insects or plant diseases, injurious or liable to become so, will be destroyed.—Dr. T. J. Headlee, State Entomologist, New Brunswick, N. J., Dr. M. T. Cook, State Plant Pathologist, New Brunswick, N. J.

NEW MEXICO.—No law relative to transportation of nursery stock. The Territorial Legislature of 1903 provided for county boards of horticultural commissioners which were given authority to control orchard pests.—Prof. Fabian Garcia, Horticulturist, Agricultural Experiment Station, State College, N. M.

NEW YORK.—All transportation companies, custom house brokers or other persons importing or bringing nursery stock into this State shall immediately upon receiving such consignment notify the Commissioner of Agriculture, of the fact that such consignment is in their possession or is enroute to some point within the State, and give the name of the consignor and consignee and the points of shipment and of destination of such consignment, and the name of the transportation company bringing such stock and the route or routes over which it was brought, and shall make such further reports relative to such shipments as the Commissioner of Agriculture may from time to time require.

It is intended that all shipments into the State shall be examined at point of destination. Shippers therefore will provide for prompt inspection if notices are promptly sent to the department. The law also provides that any person bringing trees or other plants into this State from outside the State shall before unpacking the same receive from the Commissioner of Agriculture a permit so to do. Trees or plants found infested by deleterious insects or destructive fungi will be destroyed or returned to the consignor.—George G. Atwood, Chief, Bureau of Horticulture and Nursery Inspection, Albany, N. Y.

NORTH CAROLINA.—Every shipment of nursery stock into this State must be accompanied by a valid copy of a certificate of inspection. Every person, firm or corporation desiring to ship nursery stock into this State must file a copy of their certificate with the entomologist. It will be of advantage to the nurserymen if they attach a guarantee of fumigation to the shipment. A copy of regulations will be sent on application.—Franklin Sherman, Jr., Entomologist, State Department of Agriculture, Raleigh, N. C.

NORTH DAKOTA.—The Director of the Experiment Station is authorized to cause inspection and prescribe treatment of diseased nursery stock. Shipments into the State must bear a certificate of inspection. Every person who employs agents or salesmen or who solicits for the sale of nursery stock, must obtain a license upon the payment of $10.00 and upon filing a certificate of inspection and a $500 bond. Said license will permit holder to do business in the State for one year.—Director, North Dakota Experiment Station, Agricultural College, N. D.

OHIO.—Shipments of nursery stock entering the State must bear the name of the consignor and consignee and be accompanied by an official certificate of inspection or fumigation. Transportation companies are required to notify the Agricultural Commission of all shipments of nursery stock entering the State. Agents are required to pay a license fee of $1 and dealers a license fee of $5, also to file sworn statements that the stock which they sell or deliver has been officially inspected and was received by them, accompanied with a valid certificate of inspection or fumigation.—The Agricultural Commission of Ohio, N. E. Shaw, Chief Inspector, Columbus, Ohio.

OKLAHOMA.—All nurseries are inspected annually at such times as the person in charge of the work may direct. Nursery stock shipped into or within the State must be certified.

Nurserymen, dealers or other persons residing or doing business outside of the State, desiring to solicit orders for nursery stock in the State, upon filing a certified copy of their original State certificate with the Board of this State, and upon furnishing a bond of one thousand dollars with security to be approved by the Board, shall obtain a certificate permitting such persons to solicit orders for nursery stock in this State.—Oklahoma State Board of Agriculture, Stillwater, Oklahoma.

OREGON.—The State Board of Horticulture has charge of inspection within the State. All nursery stock brought into the State must be inspected at station of delivery before delivery to consignee. If found infected or infested, nursery stock must be returned to consignor or destroyed. Peach pits, peach trees and scions and other trees on peach roots grown in or coming from districts where peach yellows, little peach or peach rosette are known to exist, are prohibited entry. Every carload and case containing nursery stock, trees, plants, etc., must have plainly marked thereon in a conspicuous manner and place the name and address of consignor; name and address of consignee; name of country, state or territory where contents were grown and must show that it contains nursery stock, seedlings or seeds. —Address State Board of Horticulture, Portland, Oregon.

PENNSYLVANIA.—Nurseries must be inspected at least once a year, and no nurseryman, agent, dealer or broker can legally sell or ship stock without a certificate of inspection. Certificates of fumigation are required to accompany shipments from other States, and the word "fumigated" printed or stencilled on or accompanying the certificate of inspection will not be accepted unless it is apparent that such word is a part of the certificate granted by a State inspection officer.

Nurserymen from other states are required to file affidavits that all nursery stock of kind subject to infestation by San Jose scale will be properly fumigated before shipment into the State. Blanks furnished upon application. Dealers in nursery stock are granted certificates upon application and the filing of a statement that they will buy nursery stock only from nurserymen or growers holding valid certificates of inspection in their respective states. Transportation companies are required to reject all stock entering the State unless certificates of inspection and fumigation are attached.—Prof. H. A. Surface, Economic Zoologist; Enos B. Engle, Chief Nursery Inspector, Harrisburg, Pa.

RHODE ISLAND.—The Inspection Law provides that the State Board of Agriculture shall appoint a State Entomologist whose duties it shall be to inspect nurseries and orchards and to grant an annual certificate for sale of nursery stock. All nursery stock shipped into the State must bear on each package a certificate that the contents have been inspected by an authorized inspection officer. The State Entomologist is, furthermore, authorized to inspect any nursery stock which comes into the State, even when sent in under an official certificate, if he deems it advisable, and shall order its return to the consignor if any injurious insects or plant diseases are found therein.

An affidavit of fumigation is no longer accepted in lieu of official inspection.

Agents who have no nursery and who wish to sell nursery stock within the State, must apply to the State Entomologist for an agent's license and must state where they propose to purchase their stock to be sold.—A. E. Stene, State Entomologist, Kingston, R. I.

SOUTH CAROLINA.—Stock coming from other states, provinces or foreign countries and consigned to points within this State must have attached to every bundle or package an interstate tag or permit issued by the South Carolina Crop Pest Commission. This interstate tag or permit can be issued only after the certificate of inspection of the State, country or province where shipment originated has been approved by the South Carolina State Crop Pest Commission and filed in the office of the entomologist or pathologist of the said commission. It is further required that the fumigation certificate of the South Carolina State Crop Pest Commission be properly filled out and filed in the office of the entomologist or pathologist of the commission before the interstate tag or permit can be issued, unless the official inspection certificate includes a statement that the nursery is properly equipped for fumigating.—Prof. A. F. Conradi, State Entomologist; Prof. H. W. Barre, State Pathologist, Clemson College, S. C.

SOUTH DAKOTA.—All nursery stock shipped into the State must be accompanied by a certificate of inspection issued by the State Entomologist of the State from which it was shipped. Any person, firm or corporation owning a nursery which sells stock to be delivered in this State must certify where the stock was grown and attach this statement to all shipments.—Harry C. Severin, State Entomologist, Brookings, S. D.

TENNESSEE.—Nurseries are inspected annually or oftener if necessary. Any person, firm or corporation without the State, desiring to do business within the State, shall file with the State Entomologist and Plant Pathologist a copy of his certificate of inspection issued and signed by proper official of his State, as well as an agreement to fumigate properly all stock shipped into the State. Every shipment must be accompanied by a copy of said certificate of inspection and a fumigation tag. Every individual sale or bill of trees shall bear a copy of certificate. Failure to comply with the requirements subjects stock to confiscation. Following is the form of required agreement to fumigate: "We, the undersigned, agree to fumigate with hydrocyanic acid gas, according to the required strength, all nursery stock subject to attack from San Jose scale and other dangerous insect pests. We also agree to attach a fumigation tag to each and every shipment going into the

State of Tennessee."—Prof. G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

TEXAS.—Nurseries and greenhouses are inspected annually. All shipments of nursery stock originating outside the State must not only bear shipping tags showing copy of certificate of inspection from the State Inspector of the State in which the shipment originates, but in addition thereto must have attached a tag showing copy of permit from Texas. Freight and express companies in this State are prohibited from receiving or delivering shipments which do not bear tags showing copy of Texas permit and they are exempt, by law, from damages arising from refusal to deliver such shipments.

No nursery stock shall be shipped into the State by any person or company without first filing with the State Department of Agriculture a certified copy of certificate of inspection from State Inspector of the State in which shipment originates. A fee of $5.00 is required for issuance of permit to ship into the State. Agents or dealers operating in Texas for nurserymen outside of the State, must procure proper agents' credentials from their nurseries, on a form furnished and approved by the Commissioner of Agriculture, and each agent or dealer must be prepared to present such credentials at all times.

Dealers are classed as nurserymen and are required to take out permit. Greenhouses and greenhouse plants are included for inspection by the Texas law, and all State inspectors should advise their nurserymen, florists or owners of greenhouses that they must have a Texas certificate before they can make shipments into the State.—Ed. L. Ayres, Chief Inspector, Austin, Texas.

UTAH.—No person shall engage in the business of selling or importing nurser stock without having first obtained a license to do business in the State. Any person may obtain a license from the State Horticultural Commission upon the payment of a fee of $2.50 annually and by filing with the State Horticultural Commission a bond in the sum of $500.00. Each salesman or agent must hold a certificate of authority giving his name and the name and address of the persons he represents, together with the license number of his principal. A copy of the certificate of inspection must be attached to each shipment. All nursery stock will be quarantined on arrival and, if deemed necessary, disinfected or destroyed at the cost of the owner.—J. Edward Taylor, State Horticultural Inspector, Salt Lake City, Utah.

VERMONT.—Nurseries are inspected annually. Nursery stock shipped into the State shall be accompanied by a certificate of inspection and the name and postoffice address of the consignor and consignee.—M. B. Cummings, State Nursery Inspector, Burlington, Vt.

VIRGINIA.—Before selling nursery stock it is necessary to procure from the Auditor of Public Accounts, Richmond, Virginia, a certificate of registration for which the fee is $20 for principals; duplicates for agents' use, free. Send certified check or draft for $20 drawn or endorsed payable to the Treasurer of Virginia. (Personal checks will not be accepted.) Duplicate of certificate of nursery inspection must be filed with the State Entomologist, who will furnish tags at cost and one tag must be attached to each package of stock to be sold in the State.—(Laws of 1903.)—W. J. Schoene, State Entomologist, Blacksburg, Va.

WASHINGTON.—No person shall sell or distribute nursery stock or solicit for sale without first obtaining a license to conduct business in the State. All licenses expire July 1st of each year and the license fee for nurserymen is $5.00 and $1.00 for agents. Every licensed nurseryman or tree dealer must execute a bond in the sum of $1,000.00.

All nurseries licensed to do business in the State are furnished with a list of the names and addresses of the inspectors and the counties covered by each in the inspection of nursery stock. The law requires that the nursery company shipping stock to a point within the State shall notify the inspector into whose district the shipment is made and send a duplicate copy to T. O. Morrison, Assistant Commissioner of Agriculture, Division of Horticulture, Olympia, Washington.

WEST VIRGINIA.—The State Crop Pest Commission has power to provide quarantine regulations concerning the transportation and sale of nursery stock. No person or corporation either for himself or as agent for another shall offer for sale, sell or deliver nursery stock unless he shall have first procured from the State Auditor a certificate of registration, the annual fee for which is $5.00.

All nursery stock entering the State must be accompanied by a certificate of inspection and also by an official permit tag obtained from the State Entomologist.—W. E. Rumsey, State Entomologist, Morgantown, W. Va.

WISCONSIN.—All persons, firms or corporations shipping nursery stock into the State are required to file a duplicate certificate of inspection of their states, and secure a Wisconsin certificate, if selling at retail or through agents. Each shipment must bear certificate tags which shall be attached to each package, box or carload lot. Transportation companies are forbidden to deliver nursery stock unless accompanied by valid certificate tags. All agents selling nursery stock within the State must be supplied with an agent's duplicate license at the cost of $1, which shall bear a copy of the certificate held by the principal. Wilful misrepresentation of quality or variety of stock offered for sale shall constitute a punishable misdemeanor.—Prof. J. G. Sanders, Entomologist, Wisconsin Department of Agriculture, Madison, Wis.

WYOMING.—Licenses are issued on application for a period terminating on July 1 of the next succeeding inspection year (approximately two years). Applications should be accompanied by the license fee of $25.00, a bond in the sum of $500.00, and by a certified certificate of inspection from an authorized inspector in the State from which shipments are to be made. On receipt of these the Secretary of the State Board issues authorized shipping tags at cost. Transportation companies may not deliver unless such tag be attached to each shipment. A copy of the law may be secured from the Secretary of the State Board of Horticulture, Prof. Aven Nelson, Laramie, Wyo.

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A PROGRAM FOR THE TREATMENT OF ORCHARD INSECT PESTS AND PLANT DISEASES.

REVISED

THE ONLY WAY TO GET PERFECT FRUIT IS TO SPRAY.
(Original.)

OFFICE OF THE STATE ENTOMOLOGIST,
INDIANAPOLIS, IND.
1916

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INTRODUCTION.

This program was originally issued to meet an increasing demand for general and adequate knowledge of when to spray, how to spray and for what to spray not only from farmers and horticulturists, but also from people living in towns and cities who have a garden or a few trees. This knowledge is set forth as briefly and completely as possible. The popularity of this program, and the constant and increasing demand for copies of it have proved that it meets a long felt need among horticulturists and farmers.

In this outline are given brief descriptions only of the insects and diseases that have proved injurious to fruits, but spray calendars for the control of the pests of both garden and orchard are included. The order of arrangement of the insects herein listed is in regard to their destructiveness, though of course, such arrangement cannot be absolute and doubtless insects and diseases that have been listed as of minor importance may in some localities become exceedingly injurious.

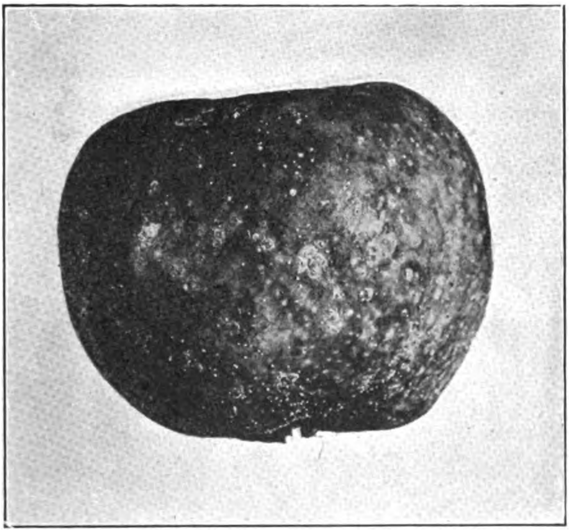
APPLE INSECTS.

SAN JOSE SCALE: The number of plants susceptible to the attacks of San Jose scale is very extensive, but those suffering in particular from its attacks are the fruit trees (with the general exception of sour cherries), and a limited number of ornamental shrubs, currants, gooseberries and a few closely related plants.

The accompanying photographs of the young scales which have very recently hatched show what one may expect to find early in June in this latitude. The young crawlers move about quite freely for about 24 hours and it is in this condition that the pest is spread from tree to tree through such agencies as wind, birds alighting upon infested trees and thereafter flying to non-infested ones, and also by larger insects which have a well-developed power of flying. San Jose scale has been disseminated far and wide by the shipment of infested nursery stock from one section of the country to another, and the introduction of this insect into the United States has probably stimulated the enaction of more horticultural and nursery inspection laws than any other single event. Our present horticultural laws were drafted at a time when San Jose scale was supposed to exist in Indiana in only a few townships, but upon making a thorough survey of the State we find that it is difficult to name the townships in which San Jose scale does not exist.

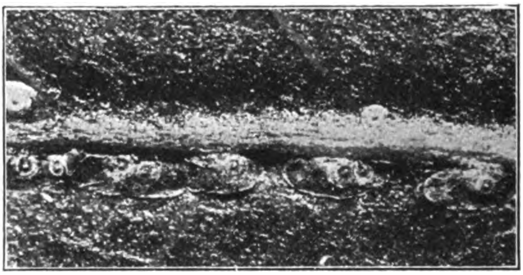
With the present knowledge concerning the control of this insect one is very foolish indeed to allow his trees to die, rather than to put into practice the control methods which have so successfully held it in check and almost eradicated it from orchards that have been given the proper care.

Control: The extermination of a pest of this sort is almost out of the question. This is especially true when the insect becomes established on larger trees that have rough, shaggy bark. The scales are sucking insects and must be killed by a contact insecticide rather than by a stomach poison, such as is used against the codling moth, Colorado potato-beetle, and similar chewing or biting insects. Boiled lime-sulphur and various kinds of oil emulsions have proved successful against San Jose scale, if properly diluted and thoroughly applied. The lime-sulphur, however, is the safest material since some of the miscible oils, if not carefully applied, produce injury to the trees. Lime-sulphur also has the advantage of being a powerful fungicide and is very useful in cleaning up the over-wintering spores of diseases which may be lodged in the cracks and crevices of the bark and about the bud scales. An application of lime-sulphur in the fall after the foliage is off and a second application in the spring before the buds have opened is advisable on badly infested trees and especially where large trees are being treated. On small trees and in cases of slight infestation one thorough application a year will be sufficient. A nozzle of the cyclone type should be used and the pump should give sufficient pressure to break the liquid into a fine mist, which will settle upon the twigs and branches and thoroughly wet the entire surface. The under sides of the limbs should not be neglected and the solution should be applied until the bark is wet enough to drip.

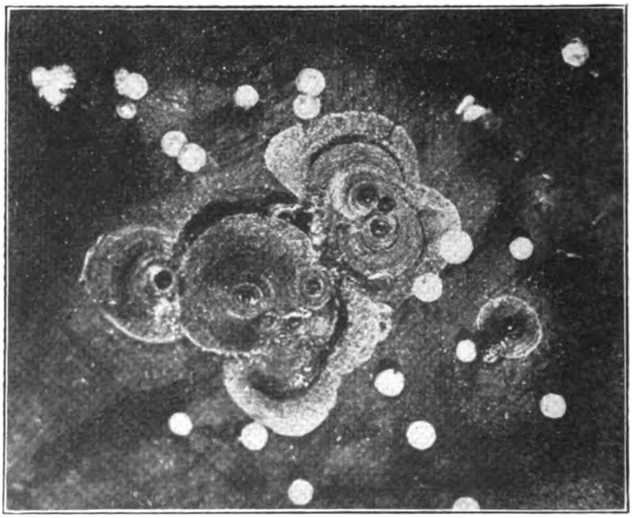


AN APPLE INFESTED WITH SAN JOSE SCALE. About natural size. (Original.)

There are numerous cases of the successful control of San Jose scale in this State as well as a large number of failures. One person will be successful using the same machinery, same spray material and having an equally badly infested orchard, while another will fail with all conditions practically the same. An evident reason for this lies in the fact that to be successful one must be absolutely thorough and conscientious and not permit his idea of thoroughness to be altered nor allow his conscience to be warped by severe pains and tired feelings in the back and arms, or by the irritating and burning sensations of the skin, which will result wherever this material falls upon it in any considerable quantity. Much of this injury to the skin may be prevented by the use of goggles and rubber gloves, and by applying the spray from such an angle that it does not drift back on the operator.

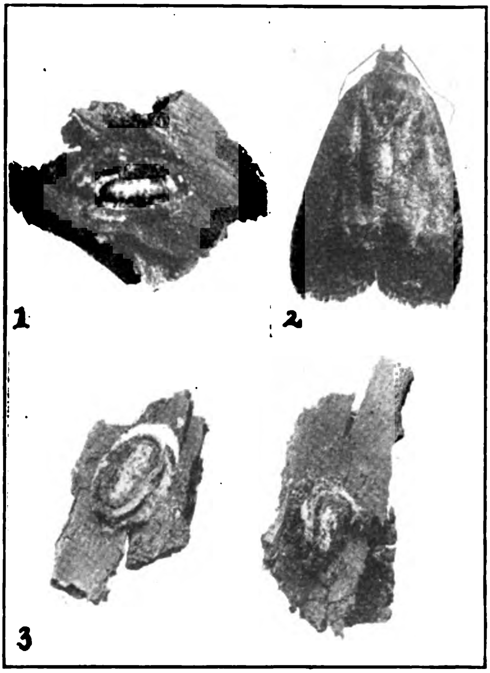


MALE SAN JOSE SCALES.



SAN JOSE SCALE. Female and young enlarged 10 diameters. (Original.)

CODLING MOTH: This insect is perhaps the most injurious apple pest in Indiana. It was introduced into America in 1850 from southeastern Europe, and since its introduction here it has spread to every section of our country where apples are grown. There is no locality in this State where codling moth is not found and it has been estimated that from 25 to 50% of the crop here is lost annually because of this pest.



CODLING MOTH.
(1) Larva. (2) Adult. (3) Cocoons.

The codling moth passes the winter in the larval or worm condition in tough cocoons, woven of silk. These cocoons may be found under the pieces of shaggy bark on the trunks and limbs of apple trees, especially in the crotches. In the absence of choice places to hibernate, such as these, they construct their cocoons in any sort of sheltered places beneath or close to the trees.

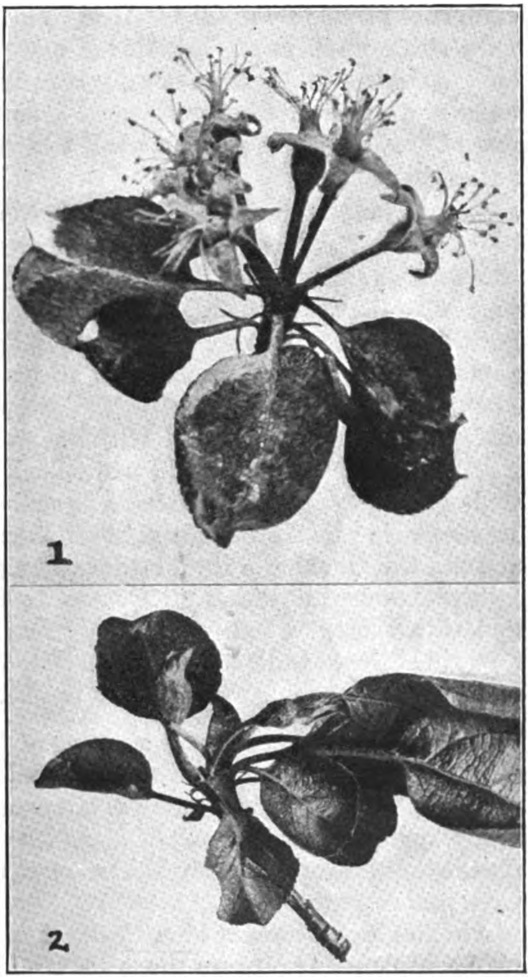
The larvae go into a resting stage in the spring when the weather begins to warm up, and remain in this condition for 25 to 30 days. The adult moths emerge over a period of several weeks but a majority of them appear about one week after the flower petals have dropped. The moths have a wing expanse of about three-fourths inch and the forewings appear like watered-silk cloth—having alternating lines of brown and bluish-gray. The hind wings are reddish-brown and darker near the margin.

The moths fly at twilight, and when they are at rest during the day on the branches and twigs of the apple tree they are well protected on account of the similarity of their color to the bark upon which they rest.

Repeated observations on the dates of the emergence of the first brood of moths in the spring and also the second brood in the summer prove conclusively that the weather conditions exert a considerable influence over the dates of the appearance of the moths. If the weather is cooler immediately following the appearance of the first brood of moths, egg laying will be delayed. The average life of the adults is ten days, during which time from 30 to 100 or more eggs are laid. The eggs are deposited principally on the surface of the leaves and sometimes on the fruit and branches. They are about 1-25 inch in diameter, oval in shape and glistening and scale-like in appearance. The first brood eggs hatch from six to ten days after they are laid while only five to six days are required for the hatching of the second brood, on account of the warmer weather. The egg-laying period of the moths of the first brood may extend over a period of several weeks, but the majority of them are laid within two weeks following the dropping of the petals and most of them are hatched within three to four weeks from the time the petals have fallen. The tiny "worms" are about 1-16 inch in length, with a shining black head. They are nearly transparent and may feed slightly on the foliage before entering the fruit. It has been the general understanding among growers that the first brood larvæ almost universally enter the apples at the blossom end and as a result of this the spraying operations have been directed toward filling the distended calyx cup with poison. Observations during the past few years, however, lead the writer to believe that for a successful control of this insect all of the foliage and fruit should be thoroughly covered with an arsenical. It has been noted that a greater percentage of the second generation enter the side of the fruit.

Everyone is familiar with the wormy apple and also the worm causing the damage. It is not unusual for the larvæ to become full grown in the fruit before the fruit drops. In cases such as this they crawl out of the fruit and hunt a suitable place for spinning their cocoons in the crevices of the bark along the trunk and larger branches.

The second generation of moths is larger than the spring generation, except in cases where spraying has been successful for the spring brood. It is not unusual also for some of the full grown larvæ of the first brood to hibernate as such and not produce moths until the following spring. It is safe to say that all larvæ going into cocoons as late as August 15th will, in Indiana, remain as larvæ until the following spring. As one goes further south the number of first brood larvæ which hibernate decreases. It should be kept in mind that the broods overlap each other and moths from the second brood may be emerging at the same time that some of



(1) CALYX LOBES OPEN. THE RIGHT TIME TO APPLY THE FIRST CODLING MOTH SPRAY. (2) CALYX LOBES CLOSED. TOO LATE TO APPLY THE FIRST CODLING MOTH SPRAY.

the belated ones of the first brood are beginning to fly. In this State there are two full broods and the season just passed showed evidence of a partial third brood.

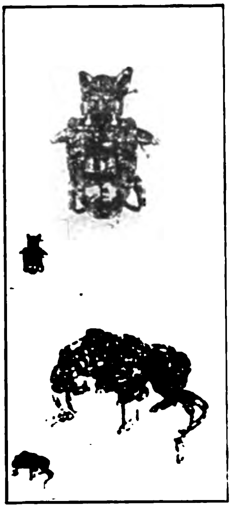
Control: Spraying with arsenate of lead as soon as the petals are off and while the calyx lobes are open and the small apples extending upward, is of prime importance. Good results have been reported from a single application, but this is not sufficient for general orchard spraying in Indiana, since there are so many fungous diseases and other insects which need attention, that a greater number of applications must be made if a high percentage of perfect fruit is desired.

The time for applying the spray for the second brood of codling moth must be determined by the grower, as one may readily understand from the foregoing discussion that no set date will apply year after year. The time that the moths which produce the second brood begin to fly may be determined by banding the trees with burlap and watching the cocoons that will be constructed beneath the bands. (All the cocoons, with the exception of perhaps three or four, should be crushed.) Within a week after the first cocoons are empty the spray should be applied. From two to three pounds of arsenate of lead paste to 50 gallons of water should be used. This should be mixed with lime-sulphur or Bordeaux mixture, thus making a combined spray against biting and chewing insects and plant diseases. Control by banding has been practiced with success where only a few trees need to be looked after, but in all cases and for commercial purposes especially, spraying will produce the most satisfactory results.

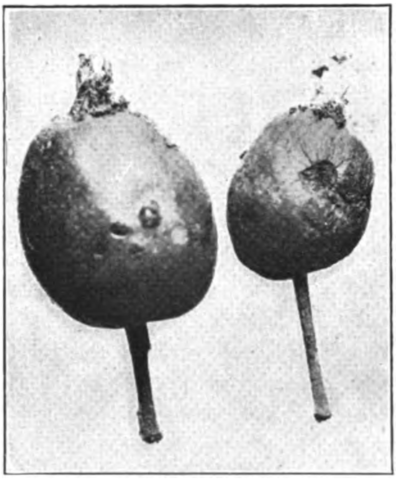
PLUM CURCULIO: This insect is a native of America and is considered by the fruit grower, and justly so, as one of our most serious pests. The seriousness of this insect is often augmented by conditions over which the grower has little or no control. This is true wherever the growers' orchards are located close to woodland or brushy, weedy fence rows.

The plum curculio breeds more in stone fruits than in the pome fruits, although considerable injury to the latter is suffered in this State every year. The loss in the United States has been estimated by Mr. Quaintance at $8,500,000 in a single year.

This snout beetle feeds in the pulp of the fruit beneath the skin, thus making control with arsenicals quite difficult. The adult beetles hibernate in rubbish of all sorts in and around the orchards and come out from their winter quarters and begin feeding on the green foliage very soon after it begins growth in the spring. About the time the young stone fruits have become formed and are the size of small peas the curculio begins its egg-laying. This is done by making a puncture through the skin and immediately turning around and depositing an egg in this puncture. A crescent-shaped cut is then made, producing a sort of flap in which the egg lies. This is done to prevent the growth of the fruit crushing the delicate egg. A single female deposits from 100 to 500 eggs and a majority of these are laid during the first month after the fruit has set. From three to seven days are required for the hatching. Affected fruits as a rule fall, but some varieties of sour cherries are exceptions to this, as practically every housewife who has had her share of wormy cherries will testify. A majority of the eggs deposited in apples never mature, as the growth of the cells surrounding the egg generally causes sufficient pressure to destroy it. The larvæ become full grown in about 20 days after the eggs are deposited and enter the ground for pupation. They burrow from 1 to 2 inches beneath the surface and there construct earthen cells. About 28 days are spent in the ground, but not all this time is required in completing the transformation, since from 12 to 16 days are passed in the soil in the larval state and the adult beetles also remain a few days before



THE PLUM CURCULIO.
Natural size and enlarged.
(Original.)



PLUM CURCULIO INJURY.

emerging. These adults seldom deposit eggs until the following spring, but considerable damage results from their feeding on both plums and apples.

Control: Sunshine has been found very effective in killing the larvæ in the fallen fruit. It is a practical control measure to rake the fallen fruit out where the sun will freely shine upon it. In view of the foregoing discussion it is very evident that thorough and shallow cultivation extending as close to the tree as possible will accomplish very good results in breaking up the pupal cells, reducing the number of adults in this way. There are some species of ants and beetle larvæ that feed upon the pupæ, and cultivation exposes the latter, making them more accessible to these predaceous insects. Frequent cultivation should be made over a period of five to six weeks, beginning the latter part of June and continuing as late as possible in August and at the same time permitting the wood to mature sufficiently to withstand the winter.

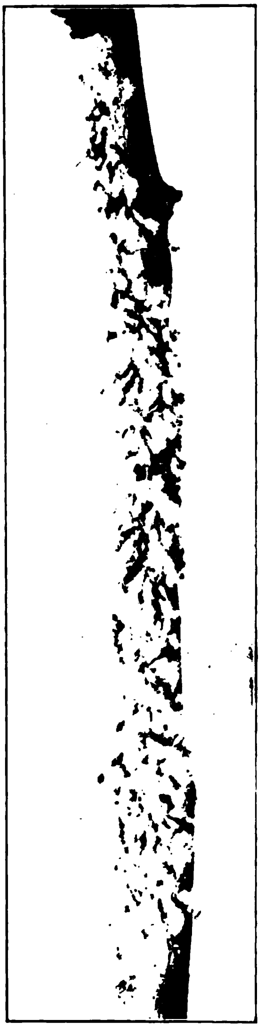
Spraying is the common and most reliable method of control. Arsenate of lead is the most successful poison because it adheres to the foliage so much better than Paris green, and it may be mixed with lime-sulphur solution, whereas Paris green should never be used in connection with this material. The commercial or boiled lime-sulphur solution can be successfully used on apple foliage and, with rather weak dilutions, on cherry and plum. The self-boiled lime-sulphur should be substituted for the boiled on peach foliage, and arsenate of lead may be added to this self-boiled solution without detracting from the quality of either the insecticide or the fungicide in the mixture. Brown rot occurs early enough in this State to justify the use of the combined insecticide and fungicide spray throughout the entire summer spraying of all stone fruits as well as apples, pears and quinces. The first application should be given stone fruits at the time the young fruit has set and the shucks or dried remnants of the blossoms are being shed.

To summarize, a combination of every practical control measure is needed to hold down the ravages of this insect. Thorough cultivation, proper and thorough spraying and a fertilizer to produce vigorous growth of the trees will reduce the losses caused by the plum curculio to a minimum.

PLANT-LICE: The number of species of plant-lice with which the fruit grower has to deal is quite large. It is important, however, that one be able to recognize the insect as a plant-louse in order that timely and effective control measures may be employed. Some species of plant-lice are fruit-tree pests only, while others appear on fruit trees during a part of the season, migrating from these to other plants, such as grasses, grains, etc. Included in this list of plant-lice with which the fruit grower is almost certain to have experience is the woolly apple-aphis, the green apple-aphis, the rosy apple-aphis, rusty-brown plum-aphis, black peach-aphis, green peach-aphis, European grain-aphis and the oat-aphis. The general farmer is likely to suffer loss from several other species which attack melons, cabbage, etc., and various other plants. The life histories of many species of plant-lice are very complicated as well as interesting, and a complete life cycle of several has never been positively determined. Plant-lice in general may be described as small insects having long legs and feelers,

TYPICAL PLANT-LICE CURLING. (Original.)

some appearing as winged forms while others on the same leaf may be wingless. Their bodies are soft and they are readily controlled by the proper contact sprays. The woolly apple-aphis, however, may be mentioned as an exception to this, since the fluffy, waxy covering of their bodies necessitates more careful and painstaking control measures. In the fifth annual report of this office there is a preliminary list of the plant-lice found in the State, in which are included brief descriptions of the more destructive plant-lice in Indiana. The following discussion on these insects was copied from the paper referred to:



WOOLLY APHIS. (Original)

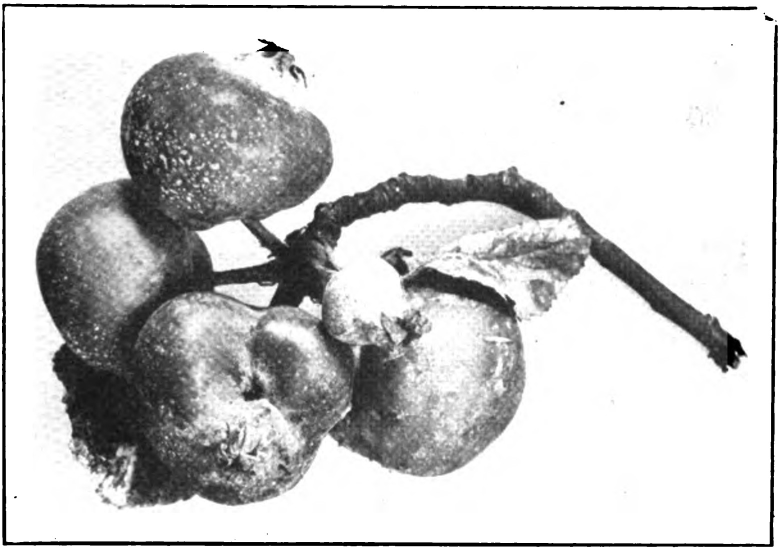
Control: As all plant-lice are sucking insects, only those insecticides can be used which kill when they touch the bodies of the lice. There are a number of these insecticides, any one of which is usually satisfactory, but a few of them seem to produce better results than the others.

The commonest contact insecticide is kerosene emulsion. This should be prepared according to the directions given under contact insecticides. The stock solution must be diluted before using. For plant-lice on anything except very tender plants, it should be diluted at the rate of about one part of the emulsion to nine or ten parts of water. For tender plants it should be diluted as much as one to fifteen. On some delicate plants it is better to use some other insecticide. The emulsion should be applied through a nozzle giving a fine mist, and only enough should be used to wet all of the insects.

Another very good insecticide is whale oil soap. It should be dissolved in water at the rate of 1 pound of soap to 6 gallons of water, and should be applied as is the kerosene emulsion.

The lime-sulphur wash has been recommended for use in winter to kill the eggs of plant-lice on the apple and other trees. For this purpose, it should be used as for the San Jose scale at the rate of 1 part of commercial lime-sulphur solution to 6 or 7 parts of water. The results of this spray have not always been uniformly satisfactory, so it cannot be recommended with certainty unless used strong enough.

Perhaps the most efficient, and certainly the most satisfactory contact insecticide for plant-lice is one of the commercial tobacco solutions. These are made up to contain a definite amount of nicotine, and directions go with each package telling exactly how to dilute it. All that is necessary is to put the liquid into the proper amount of water, stir it thoroughly and spray onto the plants.

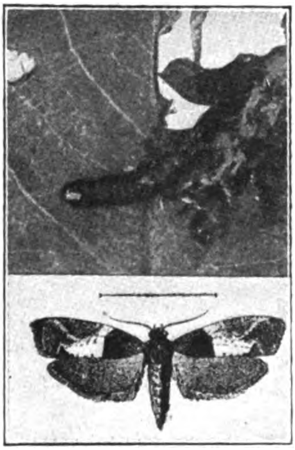


APPLES DWARFED BY PLANT-LICE. (Original.)

When good tobacco stems can be obtained, tobacco tea may be made by heating the stems in water at the rate of 1 pound of stems to from 2 to 4 gallons of water, so that the water simmers but does not boil. A spray solution made in this way should not be diluted, but should be put directly on the plants.

Tobacco dust is frequently used in nurseries and around garden plants to repel some of the plant-lice which are found on the roots of many plants. A hole is dug around the plant, or a trench made alongisde the nursery stock, and the tobacco dust is spread over the bottom, after which the earth is filled in again.

Carbon bisulphide, which comes in liquid form, is often used in controlling the woolly apple-aphis and some other root lice. A hole is made in three or four places around the base of the tree, and an ounce or so of carbon bisulphide is poured into each hole, after which it is quickly closed up again. This method is satisfactory only in porous soils, as the gas cannot penetrate a heavy soil.



BUD-MOTH LARVA AND ADULT. (After Britton.)

BUD-MOTH: This insect is rapidly becoming a very serious pest in Indiana. The larva of this moth is a brownish caterpillar with a black head, and when full grown is about ½ inch long. The caterpillar winters over in a small silken nest attached firmly to the twigs and is at this stage about ⅛ inch long. Early in the spring it bores into the buds (whence it gets its name) and sometimes into the twigs. In feeding it fastens the parts of the developing buds together by silken threads and forms a protecting nest in which it lives and feeds.

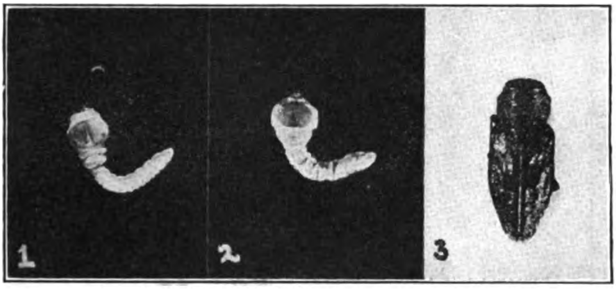
Control: On small trees this insect may be best controlled by hand picking. With larger trees, however, spraying with arsenicals is necessary and in cases of bad infestations as much as 5 pounds of lead arsenate to 50 gallons of water should be applied just as the leaf buds are bursting.

FLAT-HEADED BORER: This insect is particularly injurious in newly planted orchards, especially if weeds or cover crops like rye are allowed to remain throughout the season. In old orchards, trees affected by sun-scald furnish an ideal place for the breeding ground of this pest.

The larva of this insect is a legless grub, light yellow in color and about an inch long when full grown. The second segment behind the head is decidedly flattened and broadened, a character from which the insect gets its name.

The adult male beetle is from ½ to ¾ inch long and the female beetle slightly larger. The color is a dark bronze, almost dull metallic black. The wing covers narrow down to almost a point at the tip and are variably and indistinctly marked. The abdomen as it is seen during the flight of the insect is a bright metallic blue-green.

Control: Young trees should be headed low, and when pruning exposes limbs to sun-scald, these should be whitewashed. Trees should be kept in a healthy condition, and bark injuries avoided as far as possible and cared for when found. For other remedies see discussion under round-headed borer.



THE FLAT-HEADED BORER.
Larvae. (1) Dorsal (2) Ventral view—both natural size. (3) Adult enlarged two diameters. (Original.)

ROUND-HEADED BORER: This is one of the apple insects whose damage is usually underestimated. The growth of young trees is stunted and the foliage changes to a yellow color and drops prematurely before the real cause of the trouble is observed. This borer is detected by the castings, which are often slightly below the surface of the ground. The bark over the burrows becomes discolored and the presence of this insect may often be detected without seeing the castings.

Control: The trunk may be covered with a fine wire netting or building paper to prevent the adult female from depositing her eggs in the bark. The use of a repellant wash, such as whale oil soap, soap with crude carbolic acid—1 pint to 10 gallons—have been used. Whitewash is thought by many to be good in preventing the eggs from being deposited. At present, however, the most practical remedy seems to be that of digging the grubs out with a sharp knife. Whenever they cannot be reached by this method a flexible wire may be used.

RED-HUMPED CATERPILLAR*: This species is very similar in habits and in injury produced to the yellow-necked caterpillar. Considerable damage has been done by this pest in neglected nurseries.

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*If the codling moth and apple scab sprays are applied as directed in the spray calendar, these insects are controlled under usual conditions. If, however, a serious outbreak of these pests should occur, a separate application of three or four pounds of arsenate of lead paste to 50 gals. water should be applied when the larvae make their appearance.

The larva is marked with bright red on the head and also on the prominent hump on the fourth segment. It is from this characteristic that the insect gets its common name.

RED-HUMPED CATERPILLARS.

YELLOW-NECKED CATERPILLAR*: The yellow-necked caterpillar, unlike the tent caterpillar and webworm, does not build a nest. It, however, feeds in colonies and often defoliates large limbs and in some instances occurs in such numbers as to be quite serious.

YELLOW-NECKED CATERPILLARS.

The larval form is the one most commonly known to the farmer and is distinguished by the orange-yellow segment just back of the head. It is about 2 inches in length.

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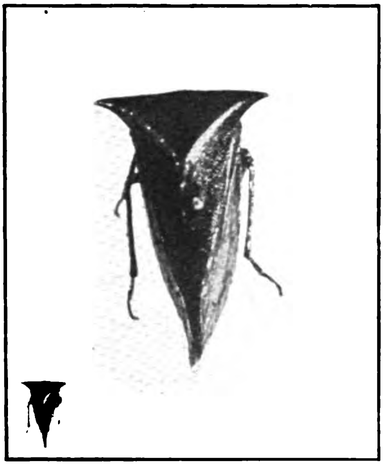
*See note at bottom of page 105.

BUFFALO TREE-HOPPER: The injury produced by this insect is a weakening of the twigs and canes made by the punctures for depositing the eggs. The injury is distinguished from that of the tree-cricket or cicada by the fact that the punctures are large and circular and are not placed in regular order.



BUFFALO TREE-HOPPER. Enlarged and natural size.. (Original.)

Control: Keep orchard well cultivated and free from weeds so that there will be no early summer food supply for the nymphs. The twigs and limbs badly injured by egg punctures should be cut out and burned.

APPLE LEAF-HOPPER: This small leaping insect is able to jump a foot or more when disturbed. It is found in orchards and nursery stock in the adult form during September and October, but no great injury has been recorded in Indiana. The greatest injury, however, is produced on nursery stock, which is stunted by severe attacks by this pest. A curling of the foliage similar to that caused by aphids is produced. These insects are blamed for carrying fire blight bacteria.

Control: Clean cultural methods as recommended for the control of the buffalo tree-hopper should be carefully practiced. Affected trees should be sprayed either with kerosene emulsion or fish-oil soap (one pound to ten gallons of water). The spray should be thoroughly applied and will kill all adults and nymphs with which it comes in contact.

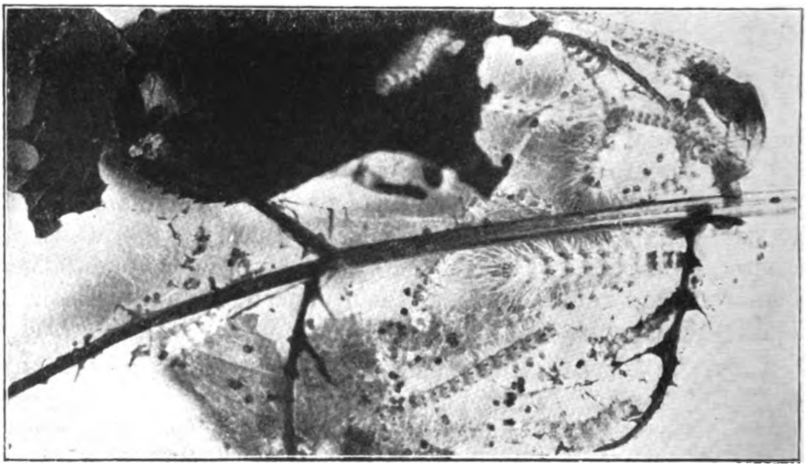
SPRING CANKER WORM*: The canker worms are known as measuring worms because of their habit of locomotion. Their damage consists of defoliating the trees in May or June. The females of this and the following species are wingless and crawl up the tree trunks to lay their eggs in the spring and in the fall, soon after emerging. Banding is therefore a good method of control. The distribution of the canker worms in Indiana is wide, but their damage is nominal.

*** See note at bottom of page 105.**

FALL CANKER WORM*: The fall canker worm is so called because the moths emerge in the late fall—as late as November and December in mild weather.

PALMER-WORM*: The injury done by the palmer-worm resembles very much that done by the canker worm. It is easily controlled by arsenical sprays as directed in the spray calendar.

APPLE-TREE TENT CATERPILLAR*: The webs of the apple-tree tent caterpillar are very conspicuous in the spring on apples, wild plum and nearly all related plants. The caterpillars are from 1½ to 2 inches in length and deep blue-black in color. They are thinly covered with yellowish or whitish hairs and have a white stripe down the middle of their backs. They are easily controlled if the codling moth sprays are applied. Burning out the nests is another way to control this pest.



FALL WEBWORMS.

FALL WEBWORM*: The fall webworm differs from the apple-tree and forest tent caterpillars in the fact that it occurs mostly in August and September. The web is distinguishable from the tent caterpillar's by the fact that it covers the foliage, whereas the tent caterpillar makes a small web in the fork of the branches and never includes the foliage.

GREEN APPLE WORMS*: These are peculiar in that they are the larvæ of genus of cutworm moths (Noctuidæ) rather than moths commonly known as fruit pests. The injury is very characteristic and consists of a more or less conical hole quite wide at the surface of the apple but tapering a little as it goes in to the fruit. This hole usually extends to the core of the fruit and often beyond.

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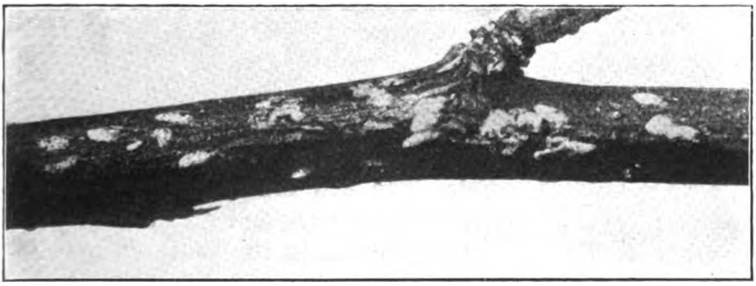
*See note at bottom of page 105.

OYSTER-SHELL SCALE†: This scale insect is very prevalent in old neglected orchards and is very often mistaken for San Jose scale. The scale of the adult female is from 1-16 to 1-8 inch in length and its color varies from light brown to black. The shape is somewhat similar to an oyster shell—a characteristic from which the insect gets its common name.

OYSTER-SHELL SCALE.

SCURFY SCALE†: Scurfy scale in many respects resembles the oyster-shell scale. The color of the female is dirty white and the scale is not quite as long as that of the oyster-shell scale and more rounded. When the eggs which may be found under the scale during the fall and winter, are crushed, they are of a deep red color and resemble blood. The male scale is much smaller than the female and is pure white in color.



SCURFY SCALE.

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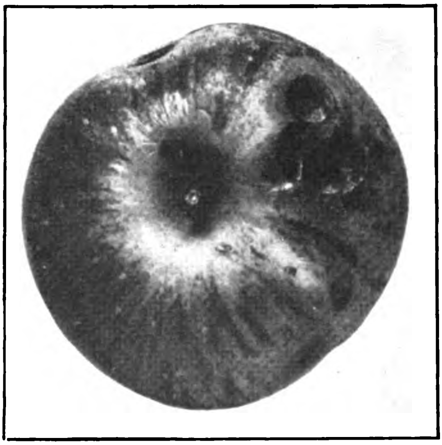
†Lime-sulphur solution, winter strength, applied as for San Jose scale will contro these insects.

APPLE CURCULIO: The apple curculio is often mistaken for the plum cuculio, and in a sense its description may be placed along with the latter. On account of its economic importance, however, it is placed near the end of the list of insects injurious to apple. It is distinguished from the plum curculio by its color, size of abdomen, length of snout, and humps on the wing covers and also the shape of the punctures.

Control: Same as for plum curculio.

TREE-CRICKETS: The monotonous cry of the tree-cricket on a summer's evening is well known to every one. These insects eat small round holes in apples, but the principal damage done by them is making punctures in the limbs during the egg-laying process. See the discussion under Blackberry Insects.



TREE-CRICKET INJURY.

LEAF CRUMPLER: The leaf crumpler, as yet, has not become a serious pest in the nurseries and orchards of Indiana. except in a few restricted localities in the southern part of the State. The winter cases of the larvæ are most commonly known and it is in this condition that it is carried from one part of the country to another. These winter cases are made of tough silken threads and are about ½ inch in length. They are attached to small twigs by stout silk threads. In this condition they resemble the bud moth.

Control: Destroy nests in the winter by picking them off and and burning them. The ordinary summer spraying with arsenicals is effective.

TRUMPET LEAF-MINER: This insect gets its common name from the trumpet-shaped mine which it makes in the leaf, which shows on the upper surface. It is only within recent years that this insect has become abundant enough in Indiana to receive attention.

TRUMPET LEAF-MINER INJURY.

Control: Plow under or rake up and burn the fallen leaves. In case of severe infestation it is advisable to spray the infested foliage with 10 to 15% kerosene emulsion. This will be effective while the insects are in the larval condition, but will not produce results after they have pupated and have become enclosed within their winter cocoons. It would, therefore, not be practical to employ this method of control later than midsummer.

APPLE BUCCULATRIX: This insect is not as a rule destructive in Indiana, but sometimes considerable damage is done by its mining in the leaves and also by its eating on the surface. It is readily distinguished by the characteristic cocoons which resemble small grains of oats.

Control: Lime-sulphur as for San Jose scale. See spray calendar.

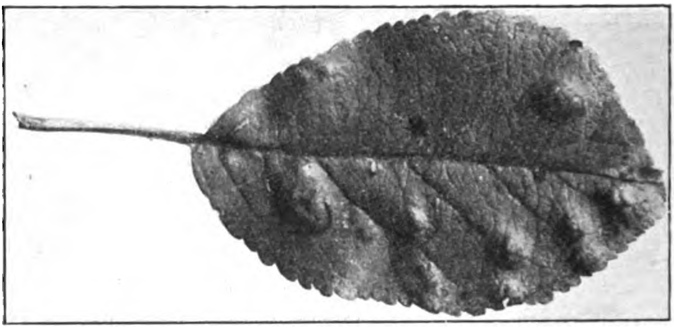
THE CASE-BEARERS: These are small caterpillars that live in pistol or cigar-shaped cases ¼ inch long, whence they get their name. They appear in the early spring with the opening of the buds and like the bud-moths feed on the surface of and bore into the buds.

Control: The control is the same as for the bud-moth.

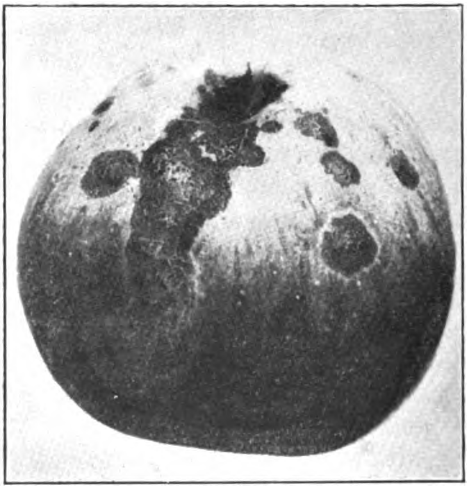
BUCCULATRIX COCOONS.
(Enlarged.)

APPLE DISEASES.

SCAB: This is the commonest and one of the most destructive apple diseases in Indiana, destroying from 25% to 60% of the crop in seasons favorable for its growth. The fruit and leaves are most commonly affected, but the leaf stalks, flowers and twigs are not exempt from the attacks of scab and much of the early dropping of the young fruit is due to this disease. Scab is very readily recognized on the leaf by the velvety, olive-green blotches caused by it. Both sides of the leaves are likely to be affected. On



APPLE SCAB LEAF SPOT.

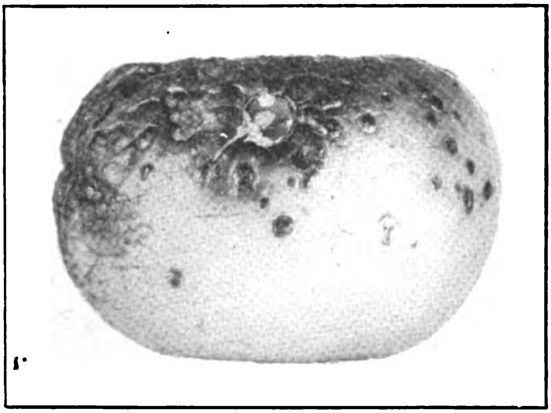


APPLE SCAB.

the fruit small greenish blotches appear at first and later the characteristic scabby surface develops from these blotches. It is believed that the spores develop superficially for a short time and then the fungus penetrates the tissue.

The effect of the disease upon the fruit is very characteristic. The part attacked ceases to grow and an ill-shaped apple results. In severe infestations deep cracks form across the diseased part of the apple very much like the cracking produced by the apple blotch.

Control: If scab is thoroughly controlled many of the other apple diseases are held in check. (See the spray calendar.) The most important single treatment for this disease is the one just before blooming and this should be thoroughly applied.



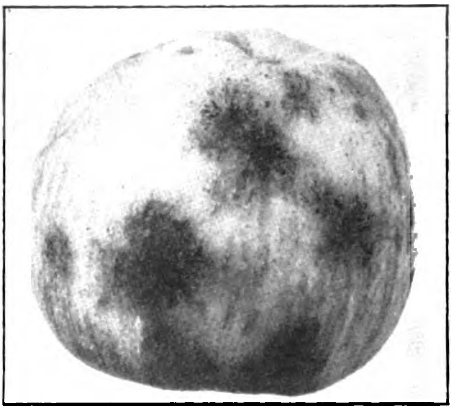
APPLE SCAB DEVELOPED IN STORAGE. NOTE BLISTER-LIKE APPEARANCE. (Original.)

APPLE BLOTCH: In the southern half of this State this disease has become very serious and is more dreaded than scab. Although the blotches on the fruit as well as the twig cankers are very characteristic of the fungus, many orchardists are annually suffering heavy losses principally through their failure to become acquainted with the disease and methods for its control. Since lime-sulphur has so successfully controlled scab, it is unfortunate that it will not work equally well against this disease—as blotch is so often confused with scab.

Blotch shows on the fruit as small, brown, irregular blotches which grow until they reach a diameter from ¼ to ½ inch. The surface of the fruit becomes rigid within the areas of the blotches which causes it to crack much the same as in a bad scab infestation. Smith Cider, Duchess and Mann are the particularly susceptible varieties in Indiana.

The twig cankers cause the water sprouts, fruit spurs and smaller twigs to have a general roughened or shaggy surface. Small brown areas about ¼ inch in diameter may be seen and it is in these areas that the fungus passes the winter, and is the source of re-infection the following year. Tiny black raised points may be seen in the brown area and from these multitudes of spores are discharged early in June.

The small inconspicuous leaf spot caused by this disease is of no particular economic importance and will be controlled along with the fruit treatment.



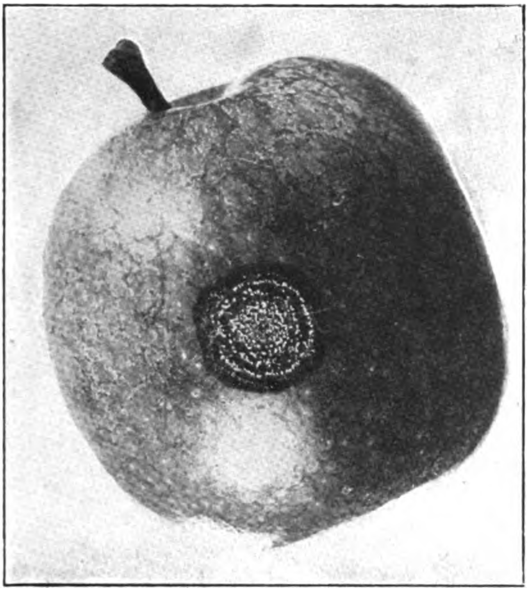
APPLE BLOTCH.

Control: Great vigilance should be exercised and spraying with Bordeaux should begin as soon as the first tiny brown spot appears on the fruit. Twig cankers should be pruned out and burned.

BITTER ROT: This disease is very destructive in the southern half of the State and is very hard to control. Bitter rot gets its name from the exceedingly bad taste that it imparts not only to the rotted, but to the surrounding area of the fruit.

On the fruit, bitter rot appears as a circular brown spot, on which are concentric rings of fruiting pustules. From these pustules pink spore masses ooze forth. Young spots are very small and have a reddish or purplish margin. A characteristic that distinguishes this disease from black rot and brown rot, is the fact that the disease spreads inward toward the core at the same rate that it covers the surface of the fruit, and a conical area that may be readily crushed out with the fingers is formed. This disease passes the winter in cankers on the limbs or in mummied fruits.

Control: As with blotch, lime-sulphur has been ineffective in controlling this disease. However, Bordeaux has proved its worth in controlling bitter rot and may be used with comparative safety after the apples are from four to six weeks old. Cutting out and burning the cankers and gathering up and destroying mummied fruit will aid greatly in controlling this disease.

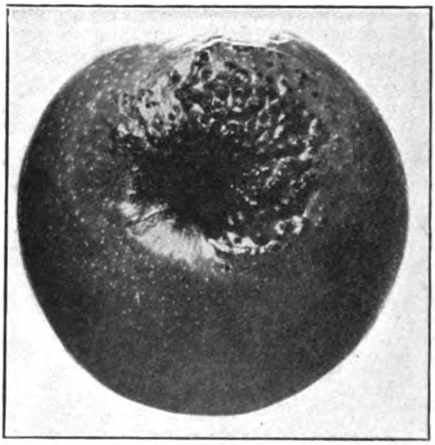


BITTER ROT.

FIRE BLIGHT: (See PEAR DISEASES.)

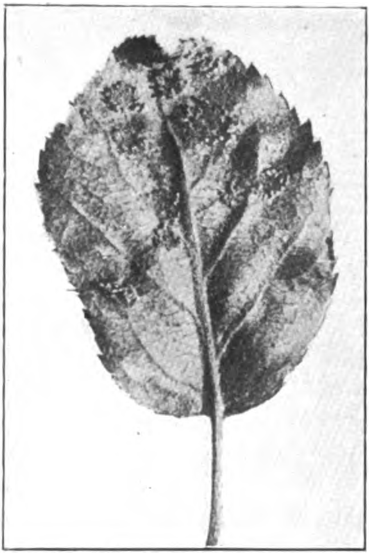
CEDAR RUST: This disease for the last few years has been unusually serious in southern Indiana and in some cases whole orchards have been defoliated by it. Cedar rust is characteristic of the "double host" rusts and needs two hosts, namely apple or other pomaceous plants and red cedar before it can complete its life cycle.

The fungus attacks the foliage and fruit of the pomaceous hosts mentioned above. The injury shows itself at first as small yellow spots which often grow to be ¼ inch in diameter. The tissue of the leaf becomes swollen on the underside, forming a blister-like structure upon, which cup-shaped spore receptacles are produced. When the fruit is attacked the spore receptacles are also produced.



CEDAR RUST ON APPLE.

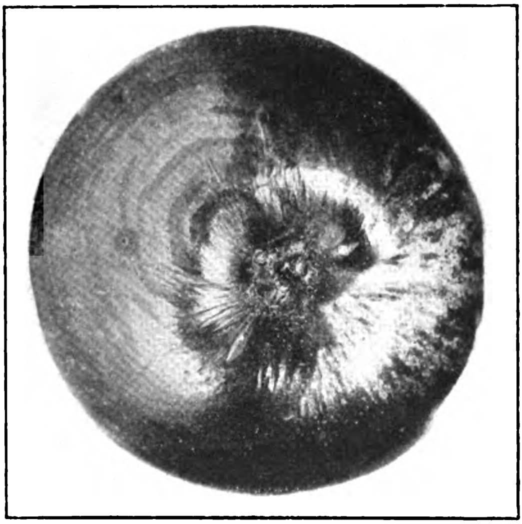
Diseased fruit is often disfigured as the infested area reaches considerable size. The spores are produced on the diseased leaves and fruit and are carried by the wind to red cedar trees. These spores



CEDAR RUST LEAF SPOT.
(Original.)

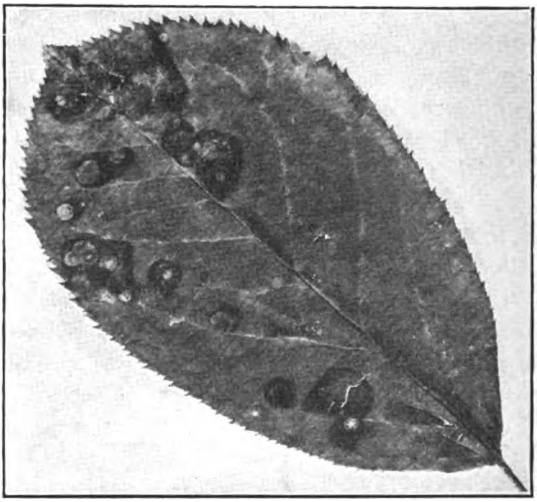
germinating upon the twigs of the red cedars produce the characteristic "cedar apples" which are globular in shape and are from ¼ to 1 inch in diameter. In the second spring after the cedar apple starts on the cedar it produces spores which are carried by the wind to apple leaves and fruit.

Control:. All red cedars should be destroyed within a radius of at least a mile of the orchard. This is particularly true of those in the direction from which the prevailing winds blow. Both small and large cedars should be destroyed as the young trees produce the "apples" the same as the larger ones. The ordinary spraying applications for the control of leaf spot and scab will do some good, but no method of combating cedar rust is more satisfactory than that of destroying all the red cedars in the vicinity.

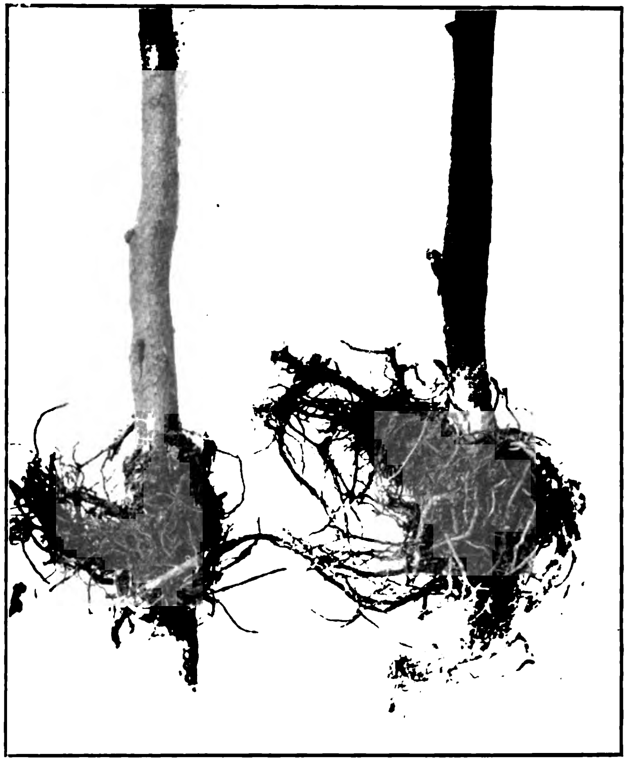


BLACK ROT ON APPLE.

BLACK ROT (New York Apple-Tree Canker and Apple Leaf Spot): The main damage by black rot is wrought by the attacks of the fungus on the foliage, these very often resulting in complete defoliation in midsummer—thus preventing the development of fruit buds for the following year's crop, and causing the fruit that may be on the trees to mature poorly. This premature dropping of the foliage is a shock to the tree and in its general weakened condition it is more susceptible to other troubles. Diseased foliage that does not drop prematurely is more or less functionless as the diseased area is useless to the tree.



BLACK ROT LEAF SPOT.

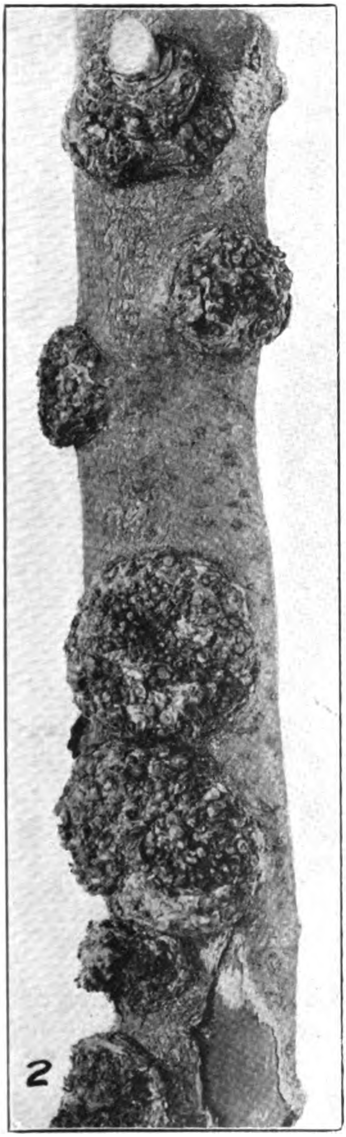


CROWN GALL ON NURSERY STOCK.

Spores are carried over winter in the cankered areas on the branches and trunks and in the diseased fruit that may remain on or beneath the tree. These start the disease on the leaves in the spring soon after they are unfolded.

Control: The scab sprays applied as directed in the spray calendar for apple will control black rot, provided these are supplemented by a cutting out and burning of the cankers at pruning time, and collecting and destroying the mummied fruit.

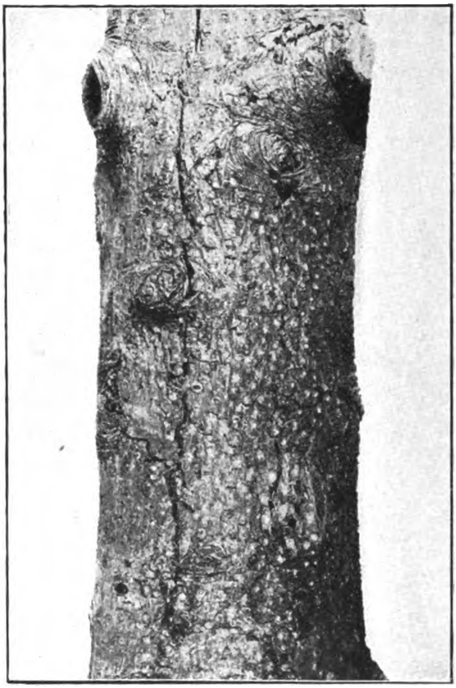
CROWN GALL: The crown gall of plants usually appears as a tumor-like growth near the ground line. Practically all fruit trees and small fruit plants are attacked by this disease, and in this State apple, peach and red raspberry seem to be most commonly affected. It is quite probable that all crown gall of plants is produced by the same organism and can be communicated from one host to another. This disease has been the subject of much contention among growers and nurserymen as it is always found to a greater or less extent on nursery stock. There is little question but that trees free from this disease and grown under practically the same conditions as affected trees will produce more and better crops and will live longer. Growers are advised to reject trees showing this disease, and nurserymen are required to cull out and destroy trees showing evidence of crown gall.



AERIAL FORM OF HAIRY ROOT.

HAIRY ROOT is an abnormal growth produced by the same organism and may appear either below or above the surface of the ground. It may be recognized by the unusual number of fibrous roots growing out from the crown and from tumors on the trunk above the ground as shown in the picture.

Control: There is no control for this disease. Trees which show traces of crown gall and hairy root should be rejected, and trees showing the aerial form of hairy root should be grubbed out and burned, while trees making slow and unsatisfactory growth with water sprouts around the crown should be examined carefully to determine if crown gall is present.

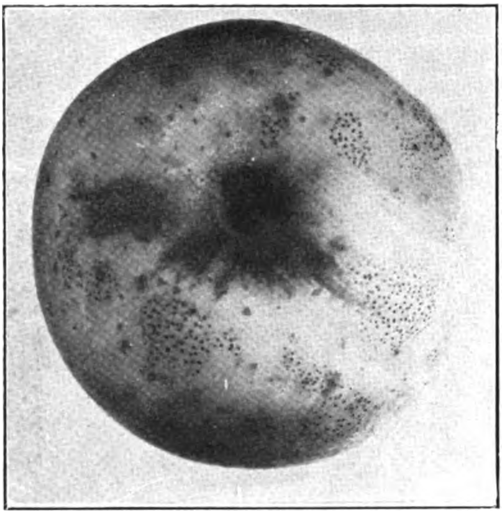


BLISTER CANKER. (Original).

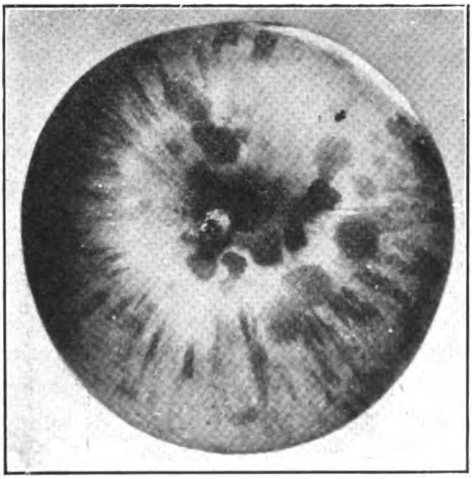
THE BLISTER CANKER OF THE APPLE OR ILLINOIS CANKER: This canker is readily recognized by the characteristic blister-like areas scattered over the affected part of the trunk or branch. The disease shows itself in its early stages by a brownish sunken area of the bark. Spots of healthy tissue exist within the infested area for a time, but these soon die.

It is believed that the blister canker is a wound parasite, and this belief is well borne out by observations on its general prevalence in orchards where careless pruning has been done. Large wounds that are left unpainted or unprotected furnish an ideal place for the entrance of this disease.

Control: Close watch should be kept and diseased parts cut out and burned as soon as they appear. Properly covering wounds with paint or other wound dressings is necessary to check the spread of this disease.



FLY SPECK FUNGUS.

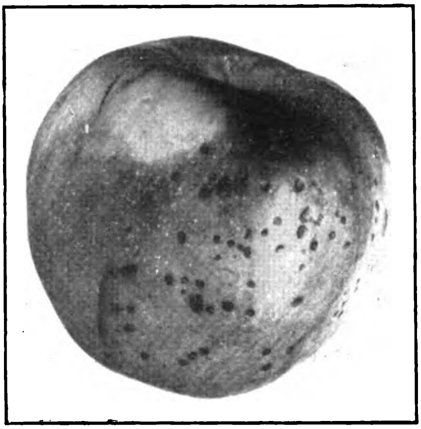


SOOTY BLOTCH.

SOOTY BLOTCH AND FLY SPECK: This disease shows itself late in the season and is especially abundant if the season has been unusually moist or the orchard is in a low, damp situation. Apples on the lower limbs that are more or less shaded suffer most. The fruit is not injured beneath the skin and the only loss is due to the unsightly appearance of the disease on the fruit, thus depreciating its market value.

Control: Since the fungus is entirely on the surface it is comparatively easy to control by spraying with either lime-sulphur solution or Bordeaux mixture.

FRUIT SPOT: This disease used to be called Baldwin fruit spot when there was still confusion between this and the following disease. Fruit spot, as it is now known, is a fungous disease that affects many varieties of apples, but is most serious on Jonathan. It appears in early August on the surface of the apple as dark colored spots. These spots become slightly sunken, corky, and turn black or brown. Slightly infected fruit that appears perfect at the time it is stored, becomes badly diseased in storage.



FRUIT SPOT.

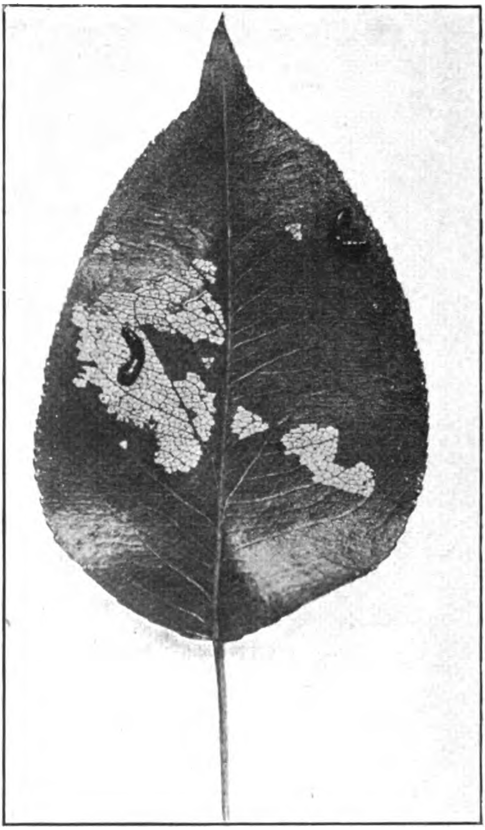
Control: Spraying in late summer with lime-sulphur sprays or with Bordeaux will control this disease.

BITTER PIT: This is supposed to be a physiological disease and thus far no methods of control have been worked out. It resembles fruit spot in general appearance, but is distinguished from that disease by the fact that in early stages it does not differ in color from the surrounding portions of the apple. The spots, which resemble hail bruises, become quite large ($\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter), decidedly sunken, and in time assume a brownish color. The tissue beneath these pits has a bitter taste—from which characteristic the disease gets its name. It usually appears first and most commonly near the calyx end of the apple.

SOFT ROT OR BROWN ROT: (See PEACH DISEASES.)

PEAR INSECTS.

The preceding list of insects injurious to apples applies almost universally to the pear and quince. In the discussion, therefore, of the insects affecting the pear there will be no repetition of those that have already been discussed in the list of apple insects. The following list, however, contains those forms which are more strictly of economic importance on the pear.



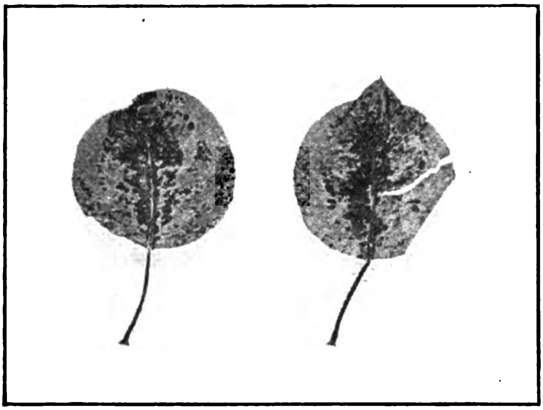
PEAR SLUG LARVAE.

PEAR SLUG: Pear slugs are dark olive-green, soft, slimy-bodied insects that skeletonize the leaves of not only pear but also plum and cherry. The larval or slug stage is the one most commonly known, and two broods of these occur regularly in this

State; the first brood from the first to the middle of June; the second, from about the 20th of July to the 10th of August.

Control: This insect is readily controlled by arsenical sprays, but if it is doing damage about the time the fruit is ripening, dusting hellebore or air-slaked lime on the trees will control it.

PEAR-LEAF BLISTER-MITE: This pest is not a true insect but a mite and therefore related to the spiders and ticks. The injury of the pear-leaf blister-mite is characterized by the production of reddish to black colored blisters which are often confluent and sometimes cover the entire leaf. In these blisters the mites live and suck the juices from the leaves.



PEAR-LEAF BLISTER-MITE INJURY. (Original.)

The adult mites pass the winter beneath the bud scales and in the spring migrate to the young leaves and produce the characteristic blisters.

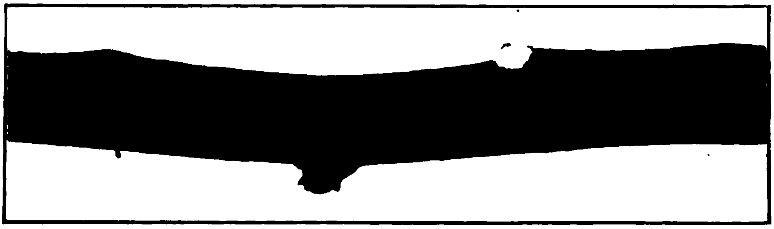
Control: Winter spraying with lime-sulphur solution as for San Jose scale will effectively control this pest.

SOME DISEASES OF THE PEAR AND QUINCE.

(For diseases not mentioned here, see Apple Diseases.)

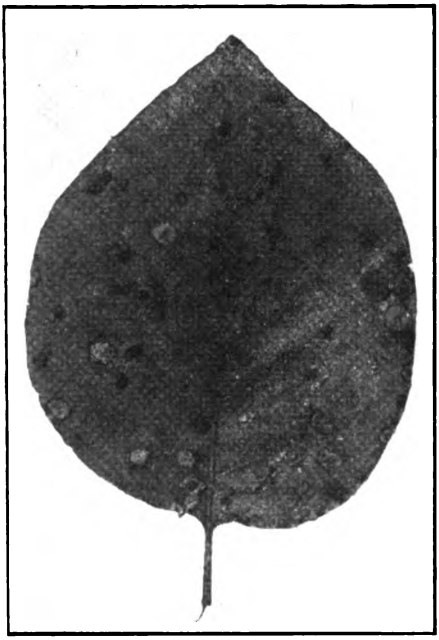
PEAR OR FIRE BLIGHT OF THE APPLE, PEAR AND QUINCE: This disease shows itself in the spring at blooming time and the part of the host that is affected wilts and begins to blacken and finally becomes quite black. The fact that the tips of the twigs and flowers first show infection indicates that the chief cause of the spread of the disease is by insects. The nectary of the flower furnishes an ideal medium for the multiplication of the bacteria and from this they work down through the twigs. The disease sometimes starts in the sappy water sprouts or twigs which are inoculated with the germ by chewing or sucking insects. The germs are not believed to gain entrance to the host on healthy tissue unless an injury of some sort is produced. The bacteria winter over in blighted twigs that have a proper supply of moisture and are protected from thoroughly drying out. From a very few of these "hold-over cankers", however, the disease may be spread very extensively during the early growing season.

FIRE BLIGHT OR PEAR BLIGHT. (Original.)



PEAR BLIGHT CANKER.

Control: Pear blight *cannot* be controlled by spraying or by any application in, on, or around the tree. None of the many so-called cures on the market that have been tested by reliable persons have shown any beneficial effects, and the orchardist should be very careful about using them or allowing his trees to be treated with them. Cutting out and burning the diseased parts, taking care to make the cuts at least 2 to 3 inches from the affected part, and sterilizing both the cut made and the implement used with a 1 to 1000 bichloride of mercury (corrosive sublimate) solution will do much to hold the disease in check. Not cultivating pear and thus making them produce a slow and hardy growth is also of value in preventing the rapid spread of pear blight.



QUINCE LEAF SPOT OR LEAF BLIGHT.

It is not advisable to attempt to grow pear trees in the vicinity of apple trees and we would advise growers who do not make a specialty of pear culture to cut down and burn all pear trees.

Perhaps the best practice to follow in the control of blight is to avoid cutting when the disease is "running" badly and to wait until after the wood has ripened (that is until late fall or early winter). If all cankers and blighted twigs are then cut out two or three inches below the end of the canker and the wounds are treated with corrosive sublimate as described above, there is little danger of spreading the disease by means of infected tools.

All cankers and twigs that have been cut out should be gathered up and burned.

LEAF BLIGHT OF PEAR AND QUINCE: The spots of this disease occur on the upper side of the leaves and are at first small with reddish-colored centers and dark borders. When the disease becomes severe the leaves turn brown and fall prematurely. This fungus is often confused with the leaf spot on the pear but may be distinguished from the latter by the fact that pear-leaf spot produces a larger spot on the leaf that is not so highly colored, is not so nearly circular, and is not so distinctly marked off from the healthy tissue of the leaf. Pear and quince leaf blight not only affects the leaves, but shows itself upon the fruit as small red spots which later turn dark, producing a rigid surface and cracking open in the center as in a bad case of scab.

Control: Bordeaux mixture or lime-sulphur solution applied at the times recommended for the control of apple scab, will be effective.

Spray Calendar for Apple, Pear and Quince.

Fire blight cannot be controlled by spraying. (See discussion under Pear Diseases.)

When to Spray.	What to Spray for.	Material to Use.	Remarks.
WINTER OR DORMANT SPRAY. In bad cases of scale infestation, it is advisable to spray both in fall and spring while trees are dormant. Spring application should be made just before buds open if possible.	San Jose, Scurfy, Oyster-shell and other scale insects, Bucculatrix, Aphis eggs.	Lime-Sulphur diluted according to table on page 175, usually about 1 part to 6 water.	This application is also valuable in killing fungous spores that pass the winter on the bud scales and other parts of the tree. It also cleans off the shaggy bark and thus destroys hibernating places for the Codling Moth and other insects.
FIRST SUMMER SPRAY. When the blossome buds show, but before the petals open.	Scab, Curculio, Bud Moth, Canker Worm, Cigar Case-Bearer, etc.	Lime-sulphur, (See Dilution Table for Summer Spray), 2½* lbs. arsenate of lead to 50 gallons of solution.	This is an important spray for scab and should be done very thoroughly. Where Curculio and other insects are not bad, 2 lbs. arsenate of lead will be enough.
SECOND SUMMER SPRAY. Immediately following the dropping of the petals.	Codling Moth, Curculio, Scab, Leaf Spot, Cedar Rust and various leaf-eating insects.	Lime-sulphur, same as for first summer spray. 2½ lbs. arsenate of lead to 50 gallons of solution.	When a large number of trees are to be sprayed, it is advisable to begin when about 90% of the petals have fallen so that it may be completed before the calyx lobes close.
THIRD SUMMER SPRAY. Where no Apple Blotch exists—about two weeks following No. 2.	Leaf Spot, Scab, Codling Moth, Cedar Rust, Curculio.	Same as above.	When Apple Blotch exists, the following third summer spray should be applied.

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*Where arsenate of lead is mentioned in the Spray Calendars, the amount recommended is for the paste form. If the powdered form is used, one-half the amount should be taken.

SPRAY CALENDAR FOR APPLE, PEAR AND QUINCE—Continued.

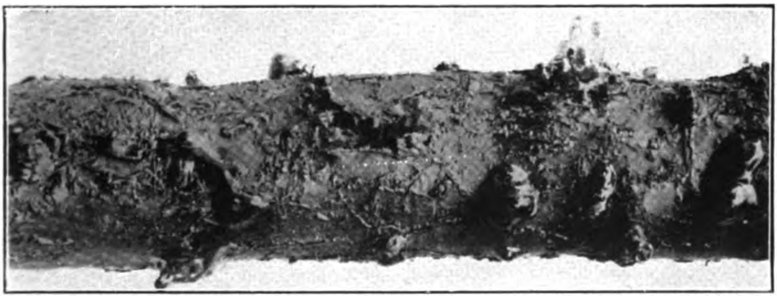
When to Spray.	What to Spray for.	Material to Use.	Remarks.
THIRD SUMMER SPRAY. Where Blotch exists—about three weeks after No. 2.	Blotch, Leaf Spot, Scab, Codling Moth, Cedar Rust, Curculio.	Bordeaux mixture 4-4-50. 2½ lbs. arsenate lead to 50 gallons of solution.	In slight infestations of Blotch and if the weather has not been unusually moist and warm, lime-sulphur as above will control it. Otherwise Bordeaux will be necessary.
FOURTH SUMMER SPRAY. The last week in June or the first week in July, depending on the latitude. Watch forCodlingMoths.	Second brood of Codling Moth, Bitter Rot, Blotch, Sooty Blotch and Fly Speck.	Lime-sulphur, and arsenate of lead as in No. 2 or Bordeaux and arsenate of lead as for Blotch in No. 3.	When Bitter Rot or Blotch exists, Bordeaux should be used instead of lime-sulphur.

When bitter rot is troublesome on apple a fifth and sixth application of Bordeaux mixture should follow the fourth summer spray, and should be made from two to three weeks apart.

PLUM AND CHERRY INSECTS.

PLUM CURCULIO: (See APPLE INSECTS.)

FRUIT-TREE BARK-BEETLE: Fruit trees infested badly with the fruit-tree bark-beetle have the appearance of having been struck by a charge of birdshot. On plum, cherry and peach—if the tree is not nearly at the point of death—gum exudes; but on pear and apple this is not the case. If one will observe one of these small openings made by the bark-beetle he may often see a small black beetle crawling in and out through the opening. This is the adult form of the insect producing the injury. It is almost a universal rule that trees weakened from some other cause are the ones that are attacked by this pest.



FRUIT-TREE BARK-BEETLE INJURY ON CHERRY.

Control: Cut out and burn all dead and diseased wood, as it is the diseased parts of the tree through which the insect is most likely to gain entrance. Good cultivation and fertilizing to produce strong healthy trees is the best preventive measure. Good results have been obtained from whitewashing with salt and a little cement added to the whitewash to make it stick to the tree, and recent experiments carried on by the Ohio Experiment Station show that carbolineum emulsion is an excellent repellant against this pest.

PLUM GOUGER: The plum gouger is often mistaken for the plum curculio but it is distinguished from the latter by the absence of the humps on its back. Its injury produces gnarled and worthless fruit like that produced by the plum curculio.

Control: The remedies used for the plum curculio will readily control this species.

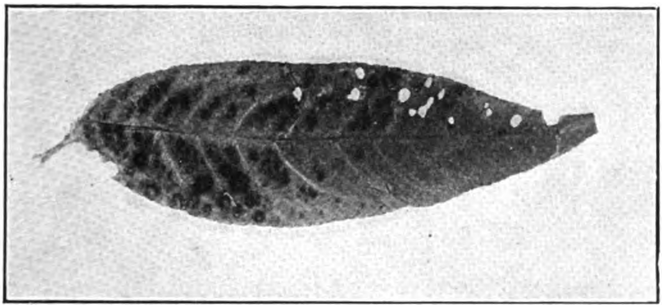
CHERRY SCALE: This scale is a native one and is sometimes found on sour cherries throughout the State. It is very often mistaken for San Jose scale but may be distinguished from the latter by its larger size and its more or less chestnut-brown color. Its life history resembles very much that of the San Jose, to which it is closely related.

Control: The remedies recommended for San Jose scale are applicable to this pest wherever it becomes serious enough to warrant treatment.

PLUM AND CHERRY DISEASES.

BROWN ROT: (See under PEACH DISEASES.)

LEAF SPOT: The "shot-hole" trouble so often found on the leaves of cherry, plum and peach may be caused by a number of different fungi. The holes in the leaves are caused by the diseased part of the leaf breaking away from the healthy tissue and falling out. The fungus most commonly causing leaf spot is *Cylindrosporium padi* Karst, and its work is known as "yellow leaf" or "shot-hole." Often this disease becomes serious enough to cause complete defoliation of the trees by the middle of July. Spore-bearing structures have been found on cherry twigs and it is quite probable that these are a source of infection in early spring.



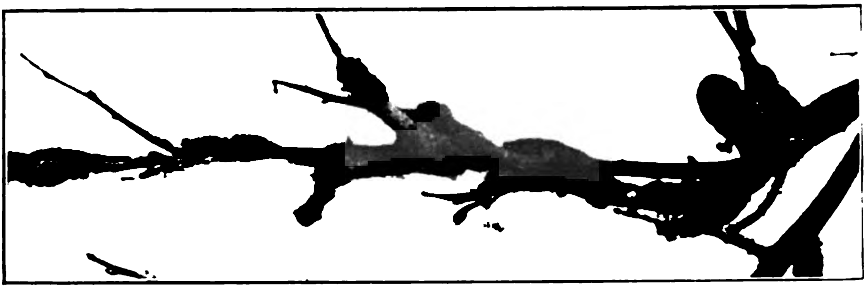
SHOT-HOLE FUNGUS ON PEACH. (Original.)

Control: Diseased leaves that have fallen should be destroyed or plowed under and an application of strong Bordeaux in the very early spring, before the buds open, or a dormant spray with lime-sulphur, together with the regular brown-rot sprays will control this trouble.

BLACK KNOT: This trouble is very common all over the country on plums and cherries, but in Indiana for some reason it shows a decided preference to plums. The native varieties of plum suffer worst, and but few varieties are free from it. Both wild and cultivated plums and cherries are subject to its attacks.

The knot is very conspicuous on the twigs and limbs and its common name expresses very well its appearance. It may extend from one to several inches along the branches or twigs and occasionally entirely girdle them, resulting in their death. It, however, is more often confined to one side of the branch. The growth usually begins in the spring and ceases in midsummer. When small branches are infested they become curved considerably on account of the increased growth on the side where the knot exists.

Control: All knots should be cut out and burned in early spring, before the spores are disseminated. Pruning out, in time will be effective. All infested wild cherries and plums in the vicinity should be destroyed. Instances are on record where large infested areas have been absolutely cleaned up merely by cutting out and burning the knots.



BLACK KNOT ON PLUM.

Spray Calendar for Cherries and Plums.

Usually the first and second summer sprays are sufficient to control the diseases and insects attacking the cherry.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
DORMANT SPRAY.	San Jose and Cherry Scale.	Lime-sulphur. See Apple Spray Calendar.	Plums are very susceptible to the attack of San Jose scale, but cherries, especially the sour varieties, are seldom troubled. Cherry scale is sometimes serious. Black Knot should be cut out and burned and Brown Rot mummies removed and destroyed.

SPRAY CALENDAR FOR CHERRIES AND PLUMS—Continued.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
First Summer Spray. When the blossom buds show, but before the petals open.	Plum Curculio and leaf-eating insects, Brown Rot, Shot-hole Fungus, Mildew.	Bordeaux 4-4-50, or lime-sulphur, 2½ lbs. arsenate of lead-paste to 50 gallons solution. "Black-leaf 40" should be added to the lime-sulphur spray if plant-lice are present.	When lime-sulphur is used on plum and cherry, 1 gallon of concentrated solution that will test 32 deg. Beaume should be diluted with from 50 to 60 gallons water. Self-boiled lime-sulphur may be substituted for the cooked in controlling Brown Rot. Bordeaux should be slightly weaker for plums of the Japanese variety.
Second Summer Spray. Soon after the husks are shed.	Plum Curculio, Brown Rot, Shot-hole Fungus, Pear Slug.	Same as No. 1.	This is a very important spray for Curculio and Shot-hole Fungus.
Third Summer Spray. About two weeks after No. 2.	Brown Rot, Shot-hole Fungus.	Same as No. 1 and No. 2, except ammonical copper carbonate should be substituted for Bordeaux on cherries.	As Bordeaux will show on the ripened cherries, it is replaced by ammonical copper carbonate for this spray.
Fourth Summer Spray. During the latter part of June.	Brown Rot of Plum, Shot-hole Fungus and leaf-eating insects.	Same as No. 1 and No. 2.	To protect the foliage of the cherry, it is sometimes advisable to spray after the fruit is gathered.
Fifth Summer Spray. For plums, soon before the fruit begins to ripen.	Same as above.	Same as No. 1 or 2, except that ammonical copper carbonate should be substituted for Bordeaux mixture.	Bordeaux used for this spray would show on the ripened fruit and should be displaced by ammonical copper carbonate.

PEACH INSECTS.

(SEE APPLE AND PLUM INSECTS FOR CODLING MOTH, PLUM CURCULIO AND FRUIT-TREE BARK-BEETLE.)

PEACH BORER: This is one of the most injurious peach insects in the State. The eggs of the borer are laid on the trunks of the trees at or near the surface of the ground and the grubs or larvæ upon hatching begin to burrow in the growing tissues just beneath the bark. In an effort to overcome the effects of the borers' work the tree exudes a considerable amount of gum at the point of injury. In this gum the pupa cases of this insect are often found. The adult of the peach borer is a steel-blue clear-winged moth about four-fifths of an inch long.

PEACH TREE BORER AT WORK.

Control: Cutting out and destroying the borers in the spring or "worming" the trees as it is called, is practically the only method of controlling this insect. "Worming" is supplemented by mounding up earth around the trees in the early part of June and allowing it to remain until September. This mound, which should be about a foot high, causes the borers to enter the tree higher up than they ordinarily would. Thus when the earth is removed, the work of borers can readily be seen and the "worm" dug out and destroyed. "Worming" should be done late in May or about the first of June and a sharp knife should be used to dig the borers out. The earth should be removed from around the crown of the tree to a depth of four to six inches, and the trunk should be scraped to remove the gum and loose bark, an operation that will destroy any of the larvæ which may be feeding on the surface protected by a mass of gum. Cutting should be done carefully and with the grain of the wood as far as possible.

LESSER PEACH BORER: This insect is similar to the preceding one. The moth, however, is smaller than that of the peach borer and the larvæ attack both the trunk and larger branches of the tree. This pest has been reported only from a few places in Indiana.

Control: Where it occurs the same method used in controlling peach borer should be employed in eradicating this pest.

TARNISHED PLANT-BUG: This insect, which is one of the true bugs, is very widely distributed and a general feeder. Its injury, however, is conspicuous on strawberries, on nursery stock —especially peach, and on various kinds of fruit. The tarnished plant-bug punctures the young growth of peach trees in the nursery row, killing the terminal shoots and forcing the tree to put out new terminals which in turn are killed until finally a stunted, ill-shaped growth is the result. We do not have positive evidence of injury of this sort on nursery stock in Indiana, but since the insect is here in considerable numbers it is reasonable to suppose that in time we will have a condition similar to that existing in some of the Eastern States where great injury has been produced on peach nursery stock.

The adult insects, which are of a pale yellowish or grayish color, are about 1-5 inch in length. They hibernate under rubbish of various kinds in a manner similar to the plum curculio and emerge from their winter quarters at about the same time as the latter. They are active flyers and will reach their feeding grounds from considerable distance. The nymphal stage covers about one month and several generations, which overlap each other, occur during the season.

Control: Sanitary conditions as set forth in connection with the discussion on the plum curculio apply also to the control of this insect. Effective control measures have not as yet been devised.

PEACH TWIG-BORER: The small larvæ of the last generation hibernate in silk-lined cells in the forks of the branches of the new growth. These hibernating larvæ are only about 1-16 inch in length and are of a reddish-brown color. In early spring the larvæ eat their way out from their winter quarters and begin feeding within the new growth of the young twigs—burrowing lengthwise through the center. The same larva will go from one twig to another, causing considerable injury, and a very small number of them are capable of killing a young peach tree by ruining the new growth soon after it has started. When the caterpillar is full grown a loose cocoon is built in roughened places on the bark and also on the new wood about the base of the leaves. The caterpillars of the second brood also attack the tips of the new growth as do the over-wintering larvæ, but they soon forsake this feeding ground and go to the fruit, where they feed around the stem end. They remain feeding on the fruit and pupate in the cavity which they have eaten out. There are three broods of this insect in this State.

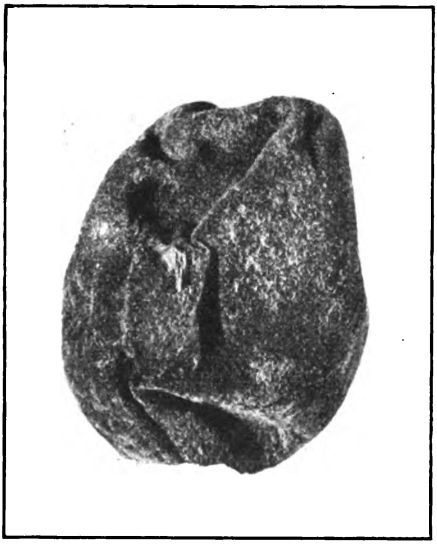
Control: Very thorough and timely spraying in the spring with lime-sulphur solution as is recommended for peach-leaf curl will be effective against the hibernating larvæ. Later injury will be controlled by the use of arsenate of lead in combination with self-boiled lime-sulphur as is recommended in the program for spraying peaches.

PEACH DISEASES.

BROWN ROT: This disease is especially bad when the weather is muggy at or near the ripening period of the fruit. The disease spreads very rapidly under conditions of this sort.

It first shows itself as small dark-colored decayed spots. These grow in size until the whole fruit is involved. The fruit retains its shape and usually does not show signs of shrinking and drying up until the rot has almost or entirely affected the fruit.

It is not difficult to recognize the fungus in its later stages by the so-called mold tufts which are grayish in color. The characteristic brown color together with its well-known hosts leave no doubt as to the trouble whenever it is seen.

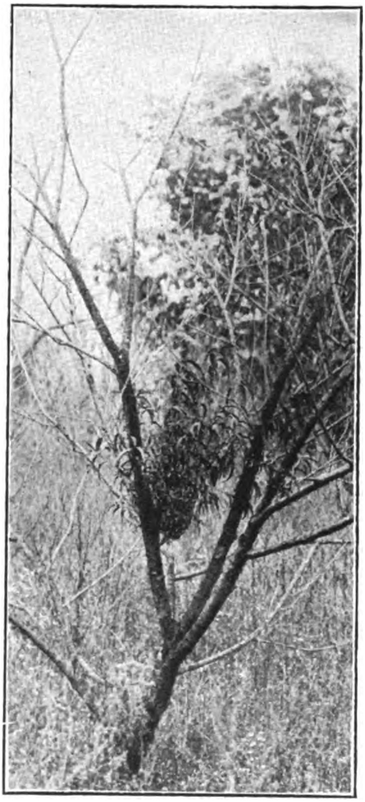


BROWN ROT ON PEACH.

Often at blooming time this disease works great damage by infecting the flowers and terminal shoots, causing them to blacken and die.

Control: Since the fungus passes the winter on mummied fruit, it is evident that an important step to take would be to remove this source of trouble. If fruit has been allowed to decay on the tree or on nearby trees the bud scales and bark are undoubtedly covered with spores that will begin to grow as soon as conditions are favorable. Spores may also be blown from long distances. Thus a dormant spraying with lime-sulphur (1 to 8) or strong Bordeaux (6–6–50) would be effective. Summer spraying with self-boiled lime-sulphur or commerical lime-sulphur except on peach will very effectively control the brown rot of stone fruits.

PEACH YELLOWS: Though for twenty years scientific men have been searching for the cause of this disease they are practically no nearer a solution of the problem than they were when they began. They have found that the disease is infectious and attacks trees at any age, and that a tree attacked is doomed to the brush heap. Perhaps the most striking characteristic of yellows is the great bunches of slender, wiry twigs that develop low on the trunk of the tree when the top begins to die. These appear two or three years after the tree becomes infected.



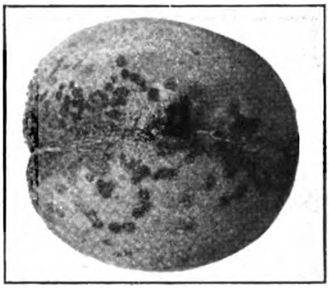
PEACH YELLOWS.

During the first year of infection there is a marked discoloration of the leaves, but this is not always to be relied on. In bearing trees there is a premature ripening of the fruit. Such fruit when cut shows characteristic bright red lines and dots throughout the flesh.

Control: The only remedy for this disease is to grub out and burn all suspicious trees, especially if yellows is known to be present in the orchard. Trees should be cut up and burned where they stood in order to avoid carrying the infection from one part of the orchard to another.

PEACH ROSETTE AND LITTLE PEACH: These are diseases of the same general nature as yellows and the method of combating them is the same.

PEACH SCAB: This disease affects the fruit, leaves and twigs of the tree. On the fruit it produces superficial round spots of a dark gray or black color, and these, as the disease advances over the surface cause the fruit to crack open. When the leaves are attacked the diseased area falls out and produces an effect similar to that caused by shot-hole fungus on plum and cherry.

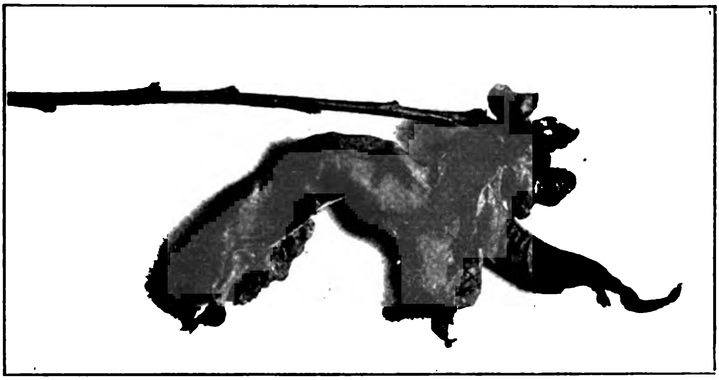


PEACH SCAB.

Peach scab winters over in brown or purple spots (cankers) on the twigs.

Control: This disease is readily controlled by the use of self-boiled lime-sulphur solution as set forth in the Spray Calendar.

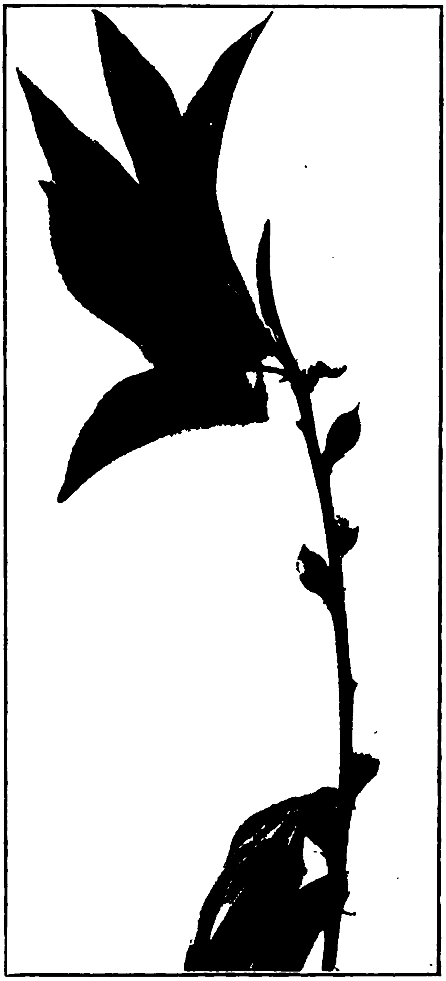
PEACH-LEAF CURL: This fungous disease causes the leaves to become swollen and malformed in the early spring and to drop in June or July. These malformations are often brightly colored. The disease also attacks the twigs, causing a prominent swelling usually at the base of the new growth.



PEACH LEAF CURL.

Control: Leaf curl is completely prevented by spraying with lime-sulphur solution at proper strength for San Jose scale before the buds open.

PEACH BLIGHT: The general appearance of this disease is much like that of the injury of the fruit-tree bark-beetle. Cutting the twig, however, shows no trace of a tunnel, but instead the tissue will be found discolored and dying. The disease affects the twigs, and the buds, causing the diseased areas to exude gum freely.



PEACHES READY FOR SECOND SPRAYING.

Control: This disease is controlled by a winter spray of lime-sulphur solution, the same as is used for San Jose scale, or by applying a winter spray of strong Bordeaux.

PEACH BACTERIOSIS: This is a bacterial disease which attacks the twigs and limbs of the tree, causing sunken areas that somewhat resemble the bitter rot canker on apple.

Control: The only control is to cut out the diseased tissue and sterilize the wound with 1-1000 corrosive sublimate solution.

Spraying for Peach Leaf Diseases: Peach foliage seems to be very tender and is easily injured by both Bordeaux and home-boiled or commerical lime-sulphur solutions used at the usual summer strength. The severity of the injury is correlated with weather conditions, moist, cloudy weather being more conducive to this trouble than clear weather. Thus to avoid the possibility of defoliating the trees, or severely injuring the foliage, we advise the use of self-boiled lime-sulphur solution, the directions for the preparations of which are given under Fungicides.

Spray Calendar for Peach.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
DORMANT SPRAY. In early spring, just previous to the swelling of the buds.	San Jose Scale, Peach Leaf Curl, Peach Blight and Brown Rot.*	Winter strength lime-sulphur as recommended elsewhere for San Jose Scale.	This spray should be applied to prevent Leaf Curl, regardless of the presence of scale. "Mummied" fruit should be gathered and burned.
FIRST SUMMER SPRAY. Following the dropping of the blossoms, when most of the "shucks" have separated from the young fruit.	Curculio and Brown Rot.	Self-boiled lime-sulphur and 2½ pounds arsenate of lead-paste to 50 gallons of solution.	Arsenate of lead is the only arsenical that should be used on peaches.
SECOND SUMMER SPRAY. Two to four weeks after the above.	Curculio, Leaf Spot, Brown Rot, Scab.	Same as above.	Concentrated lime-sulphur has been a very unsatisfactory fungicide on peach in Indiana, as foliage injury may follow the use of very dilute solutions.

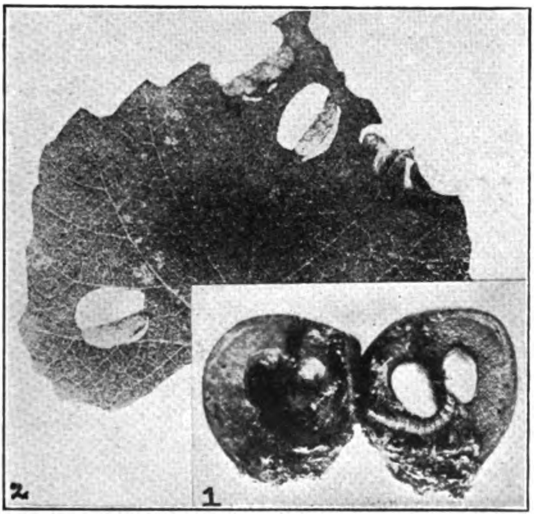
*There is no control for Yellows, Rosette and Little Peach, except grubbing out and burning diseased trees.

SPRAY CALENDAR FOR PEACH—Continued.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
THIRD SUMMER SPRAY. About a month before the fruit ripens.	Brown Rot and Scab.	Self-boiled lime-sulphur.	Peach-tree Borers and Fruit-tree Bark-beetles can not be controlled successfully by spraying. See discussions on these insects.

GRAPE INSECTS.

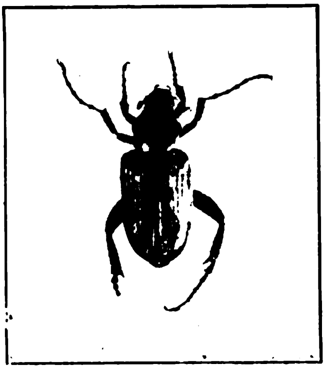
GRAPE-BERRY MOTH: This is perhaps the most widely distributed and also the most serious insect pest of grapes in the State. The larvæ or caterpillars of this moth are, when full-grown, about ⅜ inch long and of a dark olive-green to purplish color. They bore into the developing fruit, causing the appearance of purplish spots resembling those caused by black rot. Infested grapes are also matted together. The injury caused by the grape-berry moth offers splendid opportunity for secondary fungous infection.



GRAPE-BERRY MOTH.
(1) Larva. (2) Cocoons. (After Slingerland.)

Control: As the winter is passed in the larval stage in cocoons on the fallen leaves, raking up and burning the leaves in the fall or plowing them under will be a valuable supplement to the summer sprays which are given in the spray schedule for grape. "Bagging" will protect the fruit almost perfectly. This consists in enclosing the bunch of small grapes in a paper bag the mouth of which is tied tightly around the main stem of the bunch. The sack must be large enough to hold the cluster of grapes after it has fully developed. The common 2 lb. manilla sacks used by grocers are quite satisfactory.

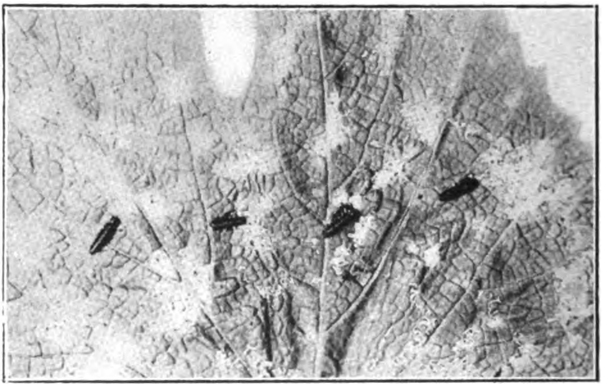
ROSE CHAFER: This insect derives its common name from its habits of feeding on roses and other plants belonging to the same family. It attacks grapes about blooming time and eats the blossoms and newly set fruit, often causing very serious injury.



ROSE CHAFER. ENLARGED.
(Original).

The adult is the form most commonly met with. It is a light chestnut-brown beetle about ½ inch long and has long awkward spiny legs.

Control: The fruit may be protected from injury from these insects by "bagging" it immediately after it is set. If spraying is to be used in controlling Rose Chafer the solution must be strong to obtain good results. From 3 to 5 pounds of arsenate of lead paste to 50 gallons of water will be necessary. In small vine-yards, hand collecting every morning will be effective



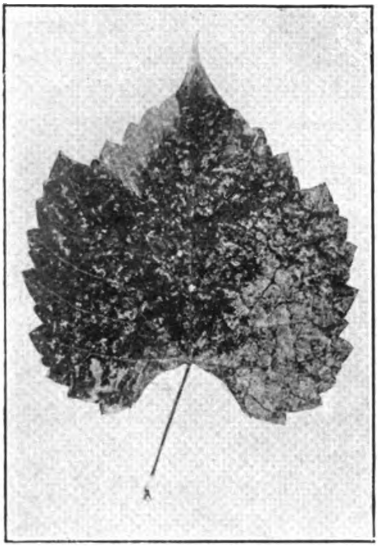
GRAPEVINE FLEA-BEETLE LARVAE FEEDING ON LEAF.

GRAPEVINE FLEA-BEETLE: This insect is called a flea-beetle because the hind legs have thick and well developed thighs, which enables the adult to jump for a considerable distance when it is disturbed. This species is quite common in Indiana and it does considerable damage both in the adult stage by eating into the buds in the spring, and in the larval stage by riddling the leaves as the season advances. The full-grown larva is dark brown in color and dotted with rows of blackish tubercles, each of which bears a single hair.

The adult beetle is robust, of a steel-blue to greenish color, and one-fifth inch long.

Control: Spray with arsenate of lead at the strength of about 2 to 3 pounds to 50 gallons solution as soon as the slightest injury is shown on the buds.

GRAPE LEAF-HOPPER: This insect is very common throughout the State and has been causing very serious damage within the last two or three years.

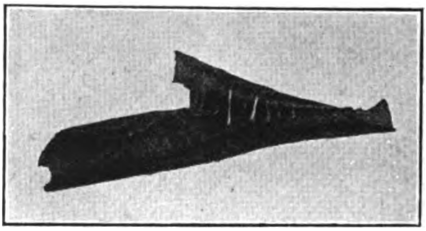


THE WORK OF THE GRAPE LEAF-HOPPER. (Original.)

As the leaf-hoppers belong to a division of true bugs, they have sucking mouth parts. Each feeding puncture makes a tiny white spot, due to the injury to the cells of the leaf, and where the injury is serious the leaf has a mottled appearance. Yellowing and premature dropping of the leaves results from continued and increasing injury. The adult, which is about ⅛ inch in length, is bright yellow and has red markings on the wings. The young are much like the adults in general form, but they are greenish in color and do not have wings.

Control: Results may be obtained by cleaning up fallen leaves and refuse in the vicinity of the vineyard, thereby reducing the number of hibernating adults. Large numbers of adults may be caught on a framework covered over with a canvas which has a coating of tanglefoot or some other sticky substance. One person may carry this along side the vines and another person shake them, causing the leaf-hoppers to jump upon the sticky canvas. The young may be combated very successfully by spraying with whale oil soap solution, 5 pounds to 50 gallons, or by spraying with a rather strong nicotine solution. This work must be done thoroughly and a nozzle adapted for throwing the spray material on the under side of the leaves is essential.

GRAPE ROOT-WORM: The injury produced on the leaves by the adults of this insect is quite characteristic, as they chew the surface of the leaves in chain-like patches. On account of the habit of the larvæ of eating on both the larger and smaller roots, it is called the grape root-worm. It becomes a very serious pest in light sandy soil and has become quite a problem in the grape growing districts. The larvæ of this insect resemble small grub worms and are entirely root feeders. The adults are brown beetles well covered with grayish hairs, and about ¼ inch long.



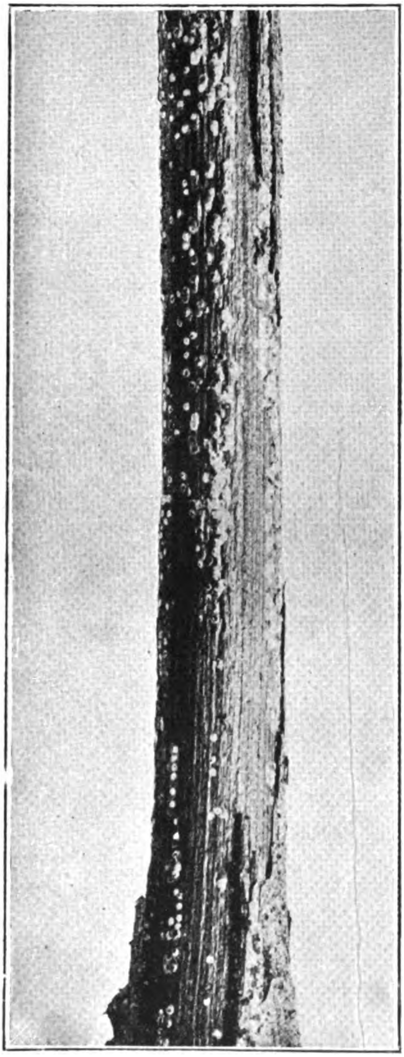
THE WORK OF THE GRAPE LEAF-FOLDER.

Control: The adults may be killed by thoroughly spraying with arsenate of lead, 4 pounds to 50 gallons of solution about the time they appear.

Since the larvæ come close to the surface to pupate and as the pupæ usually die if the cell in which they pupate is broken, thorough cultivation sometimes will be found effective. Throwing well-tilled soil up close to the vines will prevent many of the young larvæ from working their way through to the roots.

GRAPE LEAF-FOLDER: This pest has been rather serious in some localities in the State and it is not uncommon to find young vines on which every leaf is affected. The injury, which consists of eating the tissues and rolling the leaves to form a protecting case for the larva when it is feeding, is very characteristic.

Control: Raking up and burning the fallen leaves in the fall or spraying with arsenicals to kill the young larvæ before the leaves are folded will effectively control this pest.



GRAPE SCALE.

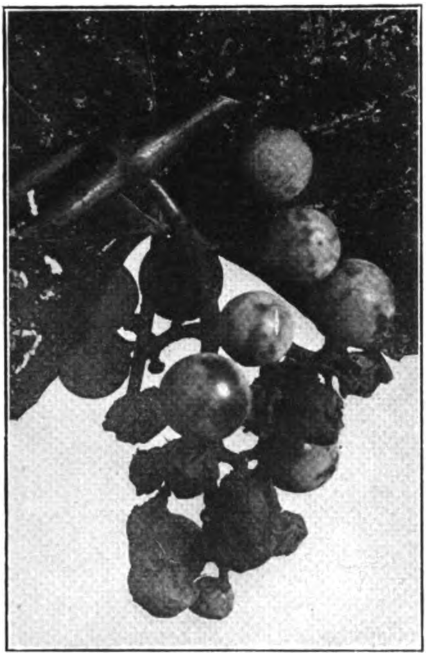
GRAPE-SCALE: This scale is found throughout the State, especially in neglected vineyards. It is usually found beneath the loose bark on the trunk or arms of the vine. It has often been mistaken for San Jose scale, from which it is distinguished by the color of the scale coverings and also by its size. The coverings are dirty gray ranging to yellowish brown. They are quite flat and circular with bright yellow apices while the nipple itself is white. This scale is similar to San Jose scale in development but there is only one brood a season.

Control: Same as for San Jose scale.

GRAPE DISEASES.

BLACK ROT OF GRAPE: This is undoubtedly the most widely distributed and most destructive grape disease in Indiana. It attacks the young shoots, leaves and fruits. On the leaves and shoots black rot causes reddish-brown spots to appear; these are clearly marked off from the healthy tissue and have circular black centers.

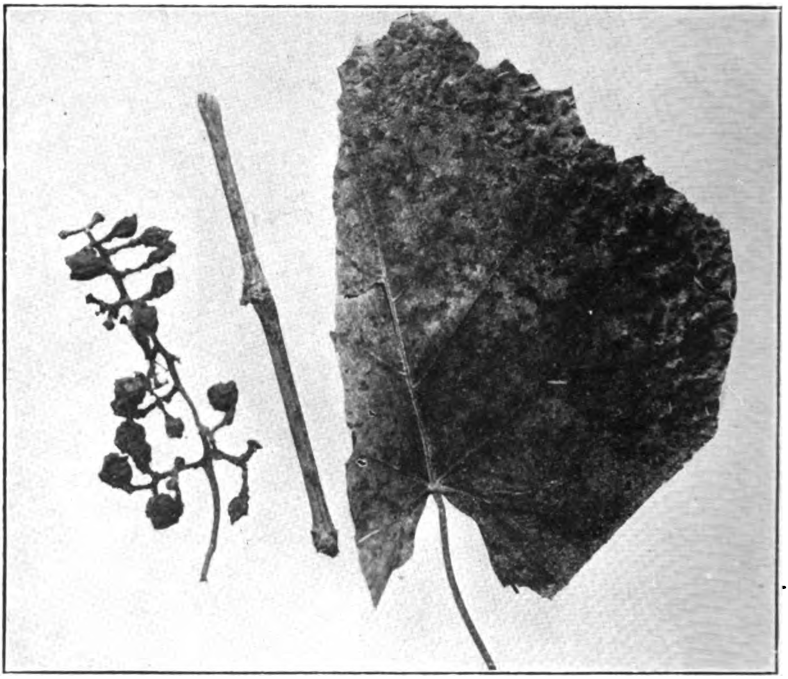
The berries are attacked when they are about one-half to two-thirds grown. A reddish-brown to black spot first appears on the berry and then spreads until the whole fruit is involved. The infected fruit turns black and becomes shriveled. Small spores develop on these mummied berries, causing a further infection during the growing season.



BLACK ROT ON GRAPES.

Control: As the disease winters in the mummied fruit and in the spots on the leaves and shoots, removing and burning these and then using a dormant cleansing spray of strong Bordeaux will do much to hold the disease in check. For summer treatment in small vineyards, sacking is practicable and effective, but on larger areas, spraying as directed in the spray calendar becomes necessary.

DOWNY MILDEW: When conditions are favorable for its development, downy mildew often becomes a very destructive disease of the grape. It attacks the foliage, causing yellowish-green spots with irregular margins on the upper surface of the leaves. As the season advances these spots turn brown. On the under side of the leaves is found a white downy growth from which the fungus gets its common name. Summer spores are produced on this growth and are carried by wind and water to the fruit and other parts of the plant. The young fruit is attacked and a downy growth appears similar to that on the under side of the leaves. The fruit becomes soft and wrinkled and usually drops when the vines are jarred. The winter or resting spores develop in the diseased parts of the plant. From these sources reinfection occurs the following spring.



GRAPE ANTHRACNOSE.

Control: All diseased parts of the plant should be destroyed when they are observed, and spraying operations as recommended for the control of black rot of grape should be followed.

POWDERY MILDEW: Powdery mildew does not usually become serious on American varieties, but is very destructive on the European or the *vinifera* sorts. Powdery mildew differs materially from the downy mildew in the nature of its growth, which is on the surface of the plant. In severe attacks of this disease the leaves turn brown and fall prematurely. The young shoots are affected in the same way as the leaves. On the fruit the fungus causes a grayish color with brown specks, and the berries do not ripen. The berries often burst open on one side, exposing the seeds. Quite contrary to the rule of fungous diseases, dry and hot weather is favorable for the development and spread of this disease.

Control: Control methods as recommended for the control of black rot will also control powdery mildew.

ANTHRACNOSE OF GRAPE: Anthracnose of grape is commonly called bird's-eye disease on account of the characteristic spot that it produces on the fruit resembling a bird's-eye. This disease has become quite serious in some localities in the State, occurring upon the shoots, leaves and berries. It is most common however, on the shoots and leaves. On the berries grayish spots, the centers of which become sunken and which are bordered by reddish bands are produced. On the shoots the spots are elongate.

Control: Cutting out and burning the diseased canes, and spraying as for black rot gives excellent results in controlling this disease.

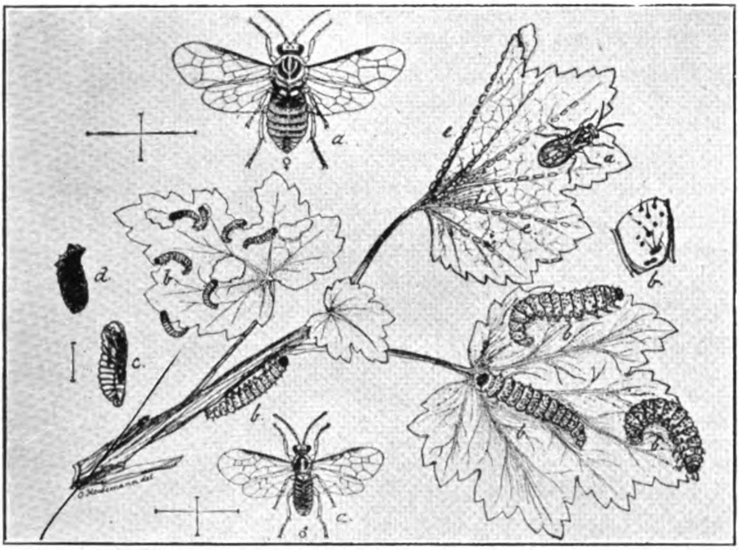
Spray Calendar for Grapes.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
Dormant Spray. Late fall or early spring before growth starts.	San Jose and Grape Scale.	Lime-sulphur, winter strength.	Grapes are occasionally found infested with San Jose Scale, but more often with Grape Scale.
First Summer Spray. Soon after the first leaves begin to open.	Downy and Powdery Mildew, Black Rot, Flea-beetle.	Bordeaux 4–4–50. 4 lbs. arsenate of lead paste to 50 gallons solution. Soap sticker.	If no Flea-beetles are present the arsenate of lead may be omitted from this spray.
Second Summer Spray. Just before blooming.	Mildews, Black Rot, Berry Moth, Rose Chafer, etc.	Bordeaux 4–4–50; 3 lbs. arsenate lead paste. Soap sticker.	
Third Summer Spray. Immediately after fruit sets.	Same as second.	Same as second.	In small vineyards it is advisable to sack the grapes immediately following this spray and subsequent sprays may be abandoned if no insects or diseases are damaging the foliage.
Fourth Summer Spray. About 15 days after third.	Same as third.	Same as third.	These two sprays are primarily for the control of Black Rot and other diseases and insects will be controlled incidentally.
Fifth Summer Spray. About 15 days after fourth.	Same as fourth.	Same as fourth.	

Note.—If the nymphs of the grape leaf-hopper appear, control measures as recommended under the description of this insect should be followed.

CURRANT AND GOOSEBERRY INSECTS.

IMPORTED CURRANT WORM: This is the most common and destructive currant and gooseberry pest in the State. It begins its work early in the spring by skeletonizing the leaves of its host plants. The larvæ are about ¾ inch long when full grown and range from pale to grass-green in color. The adults are typical saw-flies about ⅓ inch long and resemble the adult of the pear slug.



CURRANT WORM.

(a) Adult male and female. (b) Larva. (c) Pupa. (d) Cocoon. (e) Eggs. (After Lugger.)

Control: Spraying with arsenate of lead when the larvæ appear is the most practical method of control. If the remedial measures must be taken after the fruit has begun to ripen, it is advisable to dust the bushes with powdered hellebore instead of using an arsenical spray.

IMPORTED CURRANT BORER: This insect attacks and kills the canes of both currants and gooseberries by boring through the pith. The larva is about ½ inch long and of a pale yellow color. The adult is a clear-winged moth and resembles the adult of the peach-tree borer except in size. It is lustrous blue-black in color and has four yellow bands on its body.

Control: Affected canes are distinguished by the withered, yellowish appearance of the foliage. These should be cut out and burned as soon as they are discovered.

CURRANT AND GOOSEBERRY DISEASES.

ANTHRACNOSE: This disease affects the leaves, fruit stalks, berries and canes of its hosts. The fungus winters over in affected canes and in the spring infects the leaves from this source. On these it produces small brown spots. Seriously affected leaves turn yellow and drop off, and the plant may be defoliated before the fruit is ripe. On the petioles of the leaves and on the canes, anthracnose produces small blackish areas, and on the fruit it forms small round spots.

Control: Spraying with Bordeaux as directed in the spray calendar is the best method of control.

LEAF SPOT: This disease is produced by at least two different fungi, but the spots are so much alike that only a microscopic examination can distinguish the causal organism. The spots are rather large, circular in outline, and have a pale, gray center and a brown border. This disease is very common throughout the State and often causes serious defoliation on both gooseberries and currants.

Control: Spraying with Bordeaux mixture as for anthracnose will also control this trouble.

POWDERY MILDEW: This fungous trouble is especially serious on gooseberries, though it sometimes causes injury to currants. It attacks the leaves, stems, and particularly the fruit, giving them a whitened, fuzzy appearance much as if they had been dusted in patches with a white powder. Careful inspection of these patches shows them to consist of thickly matted fine threads, which are densest in the center of the blotch. As the disease advances the spots coalesce and turn brown. Berries that are attacked become deformed, crack open and decay. Attacked leaves turn brown but remain on the stems.

Control: Spraying with a strong solution of liver of sulphur (potassium sulphide)—one ounce to two gallons of water—seems to be a good remedy for this disease. Lime-sulphur solution 1–40 or 4–4–50 Bordeaux are also very effective in controlling this trouble.

Spray Calendar for Gooseberries and Currants.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
DORMANT SPRAY. Late winter.	San Jose Scale.	Lime-sulphur as for apple.	See remarks in Apple Spray Calendar.
FIRST SUMMER SPRAY. When leaves appear.	Mildew.	Lime-sulphur solution diluted 1–40, Bordeaux mixture 4–4–50, or Potassium-sulphide, 1 ounce to 2 gallons of water.	If the mildew infestation is serious, use once every two weeks.
SECOND SUMMER SPRAY. When "worms" first appear.	Currant Worms and Leaf-spot.	Use lime-sulphur or Bordeaux mixtures as above and add 2½ pounds of lead arsenate paste to each 50 gallons of solution.	
THIRD SUMMER SPRAY. When fruit is half-grown.	Same as above.	Same as above or use hellebore.	If the fruit is too far advanced, hellebore dusted on will control the worms.
FOURTH SUMMER SPRAY. After the fruit is picked.	Leaf-spot and Plant-lice.	Lime-sulphur or Bordeaux mixed with "Black-leaf 40".	If there are no plant-lice on the currants or gooseberries, the "Black leaf 40" may be omitted. In Indiana a fifth spray is usually unnecessary.

The third and fourth summer sprays should be applied only when the attacks of insects or diseases are serious enough to make treatment necessary.

RASPBERRY AND BLACKBERRY INSECTS.

CANE BORERS: There are two cane borers in the State that are destructive to raspberries and blackberries, the raspberry cane-borer and the red-necked cane-borer. The first named pest belongs to the same family of beetles as the round-headed apple-tree borer and the other to the same family as the flat-headed borer. The injuries caused by these two forms as well as the differences in the adult beetles serve to distinguish them.

The raspberry cane-borer is about ½ inch long, deep black in color, with the exception of the thorax (the part between the head and body), which is yellow and bears two or three black spots. The body of this beetle is long and slender with the sides parallel and the antennæ are as long as the body. Injury by this insect is caused, both by the adults and the larvæ or grubs. The females girdle a shoot by cutting two rings an inch apart around it and then laying an egg between these rings. The injured shoot soon withers and dies and the grub hatching from the egg burrows through the pith to the base of the cane, killing it.

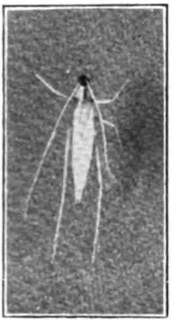
The red-necked cane-borer is about ⅓ inch long with brownish black, lustrous wing covers and with a coppery-colored neck and thorax. The body is flattened and tapers at the end of the abdomen. The injury caused by this insect consists of gall-like swellings which have numerous slits, and which are caused by the working of the larvæ in the bark layer of the canes. Infested canes rarely ripen fruit and usually die during the season.

Control: Cutting out and burning infested canes as soon as they are noticed is the only remedy to be used in controlling the cane borers.

RASPBERRY BYTURUS: This pest affects only red raspberries. The beetles are about one-seventh of an inch in length, a reddish brown in color and have a covering of pale brownish hairs. They appear early in May and work serious injury by skeletonizing the tender foliage and eating into the flower buds. The little white grubs, which are about ¼ inch long, make their appearance about the last of June or early July and burrow into the fleshy heads on which the fruit is borne. This causes an early ripening of the affected fruit, making it small, tasteless and unfit for consumption. The larvæ often cling to the inside of the berry, necessitating a sorting of the fruit and injuring its sale.

Control: Since the beetles feed freely on the young foliage, spraying this early in the spring with arsenate of lead at the rate of 3 to 4 pounds per 50 gallons of solution will prevent a great part of the subsequent injury by killing the adults and preventing egg laying. Thorough cultivation close to the bushes in the fall will destroy many of the pupæ, in which condition this insect hibernates.

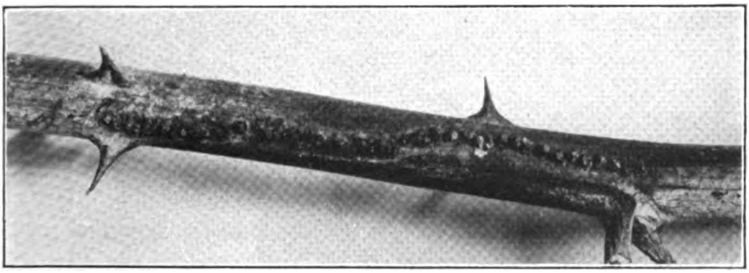
TREE-CRICKETS: There are at least three species of tree-crickets that deposit their eggs in the canes of raspberry and blackberry. The first of these is the snowy tree-cricket, which deposits its eggs singly "at the sides of dormant buds in the fleshy region at the axils of the leaves."



A TREE-CRICKET.

The four-spotted tree-cricket, though sometimes found in raspberry plantings with the snowy and striped tree-cricket is of no economic importance. The striped tree-cricket is the species that is more injurious both to raspberries and blackberries and deposits its eggs in long rows in the canes. Serious loss is often caused, particularly in raspberry plantings, as the injury made in the deposition of so many eggs often causes the death of the terminal growth and a breaking off of the cane.

The adult insects are frail, greenish-white cricket-like creatures about ½ inch long and difficult to distinguish from each other.



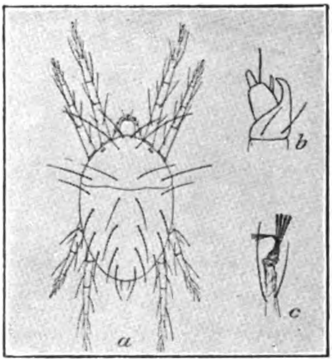
EGG PUNCTURES OF STRIPED TREE-CRICKET IN BLACK RASPBERRY CANE.

Control: Cutting out and burning the infested canes is the best method for controlling tree-crickets.

BLACKBERRY GALL-MAKER: The injury of this insect is a large pithy gall that is from one to three inches long and an inch or more in diameter, of a reddish-brown color and divided into three or more compartments by furrows that are parallel to the long axis of the gall. The gall is caused by the work of the small white grubs or larvæ of one of the hymenopterous gall-flies (which are related to the bees, wasps and ants). Each larva occupies a single cell into which the larger compartments are divided. Though of little economic importance these large and noticeable galls are frequently sent in to this department for determination.

Control: Cutting out and burning infested canes in the winter is the only remedy.

RED SPIDER: This pest is not an insect but belongs to a division of the spider family known as the spinning mites. These mites spin very fine webs on the underside of the leaves which can scarcely be noticed and these webs form a protection within which the mites feed on the juices of the plant. Red spiders have been causing serious damage to raspberry and blackberry plants because they suck the juices from the leaves and cause them to turn a rusty brown and then fall off. The adult spider is hardly visible to the naked eye, but if the underside of an affected leaf be magnified they may be seen crawling among their webs. The color of these creatures is reddish or orange red and there is a dark spot on each side of the body. The legs and body are covered with a number of heavy bristles.



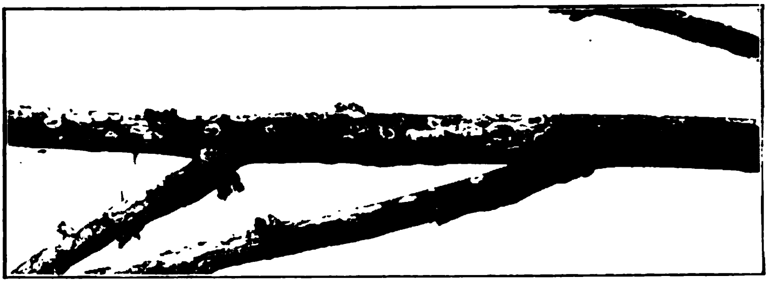
THE COMMON RED SPIDER.
(a) Adult. (b) Palpus. (c) Claws.
a, greatly enlarged; b, c, still more enlarged. (After Banks.)

Control: In dry seasons practical control measures must often be taken to hold this pest in check and we have found that flour paste, used at the rate of 8 pounds to 100 gallons of water, or flour paste, used at the rate of 4 pounds to 100 gallons of water with one gallon and a half of concentrated lime-sulphur solution added to every 100 gallons of mixture, are very effective in controlling the red spider. (For directions for making flour paste see Contact Insecticides on page 178.)

RASPBERRY AND BLACKBERRY DISEASES.

ANTHRACNOSE OF RASPBERRY AND BLACKBERRY: Raspberries are usually more seriously affected by this disease than blackberries. The spots on the canes are first small and purplish but later turn gray and become sunken. It is not unusual to find raspberries so severely infested with anthracnose that the whole cane will have a scabby appearance. Very small spots may occur on the foliage, but this part of the plant is not usually damaged by the disease.

Control: Anthracnose is best controlled by setting plants free from infestation, or from uninfested patches and in localities where none of its hosts have been recently grown. Canes showing the disease should be cut out and burned as soon as discovered.



RASPBERRY ANTHRACNOSE.

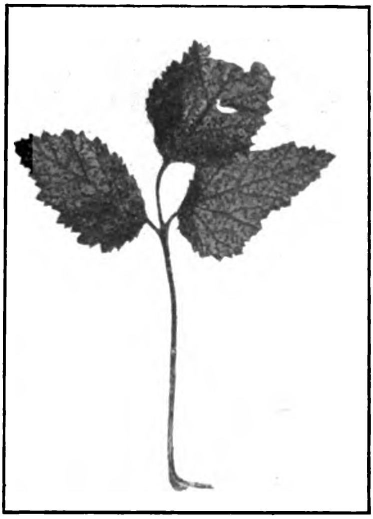
Proper rotation and cutting out infected canes as they appear seems to be the most effective way of handling this trouble. Good results, however, have been reported from spraying with strong Bordeaux mixture immediately preceding the opening of the leaves. For best results one should combine all of the above control methods.

ORANGE RUST: The usual hosts of this disease are the black raspberry and blackberry. The fungus appears early in the spring but is not conspicuous in this early stage. The affedete plants, however, show a poor growth and are spindling and will eventually die. The spores are developed beneath the epidermis of the under side of the leaf and when the skin breaks it shows myriads of bright orange-colored spores. It is these spores that spread the disease. They germinate immediately upon contact with any other host plant.

Control: All infested plants should be dug out and burned as soon as they are discovered.

CROWN GALL: (See Apple Diseases).

RASPBERRY CANE-BLIGHT: Both red and black raspberries are attacked by this disease which causes a sudden wilting and drying up of the foliage of the fruiting canes, thus killing them. Infection occurs through injuries, such as pruning wounds, and insect feeding and oviposition wounds.



ORANGE RUST ON BLACKBERRY LEAVES. (Original.)

The bark of the diseased canes is lighter colored than the healthy bark and the wood is much discolored and brittle.

Control: Since the disease is carried on infested nursery stock and even on soil around diseased plants care must be taken in getting healthy stock and in so pruning plants that the disease is

CROWN GALL ON RED RASPBERRY CANE.

not spread. Raking up and burning the pieces of dead canes on the ground around the plants removes a source of infection. In pruning, the same general method should be used as is described under fire blight of pear.

LEAF SPOT: This disease produces small ashen spots with reddish borders on the leaves of raspberry, blackberry, and dewberry but seldom becomes serious enough to necessitate special treatment.

Spray Calendar for Raspberries, Blackberries and Dewberries.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
DORMANT SPRAY. Late winter.	Anthracnose.	6-6-50 Bordeaux mixture.	Rose Scale is seldom a serious pest in this State, so a special spray for this insect is generally omitted.
FIRST SUMMER SPRAY. When new canes are about 6 or 8 inches high.	For Anthracnose*, and Leaf-spot.	Bordeaux 4-4-50.	These sprays should be supplemented by cutting and burning the old canes after the fruit is picked.
SECOND SUMMER SPRAY. About three weeks after first.	Same as above.	Same as above.	If worms are eating on leaves add lead arsenate paste at the rate of 2½ pounds to 50 gallons of solution.
THIRD SUMMER SPRAY. About three weeks after second.	Same as above.	Same as above.	Same as above.

*Orange rust cannot be controlled by spraying, so all diseased plants must be dug up and burned as soon as noticed.

STRAWBERRY INSECTS.

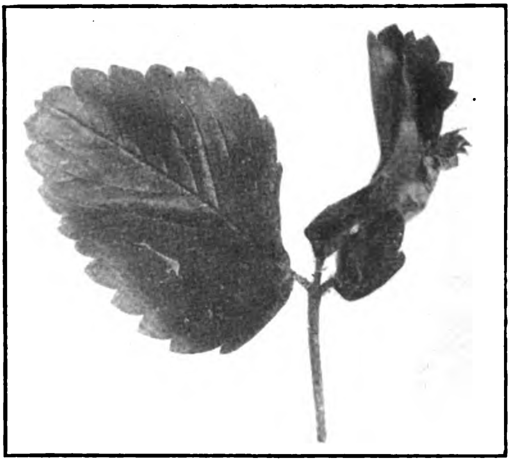
THE STRAWBERRY ROOT-LOUSE: Strawberry beds are often infested with this louse, which causes the plants to wither and die. The aphids are about 1-20 of an inch long and dark green or blackish in color. Most of the injury is done in light sandy soil. The insects attack the roots, often covering them completely. The tiny eggs may be found along the stems and mid-ribs of the green leaves in fall and winter. They are black and shiny. The young lice, which hatch from these eggs in the early spring, begin to form colonies on the tender leaves of the crown of the plant. In two or three weeks the ants, which are the constant attendants of these lice, appear and carry the aphids down to the roots of the plant. These ants protect the plant-lice during the summer and take them to new food plants when the old ones die.

Control: Plants that are not infested should be secured, and they should be planted on land that has had no infested plants on it. The plants can be disinfected by delaying the planting till all of the eggs have hatched, and then dipping them for a few minutes into dilute tobacco extract solution. Where a new bed is to be planted near an old one, the latter should be destroyed the previous fall to prevent the winged lice from migrating to the new plants. Perhaps the best way to lessen the number of lice in an old bed is to burn it over carefully with a quick, hot fire. This should be done in early spring just as the plants begin to grow by spreading straw or grass over the bed and setting fire to this.

STRAWBERRY LEAF-ROLLER: In this State this insect frequently becomes a serious problem to strawberry growers and local outbreaks have been very common in the northern part of Indiana in recent years. Like the larva of the grape leaf-folder, the larva of this insect has the habit of folding or rolling up the leaves. This affords it protection while feeding on the leaf tissues and in consequence of the injury the leaves turn brown and die. The larval or caterpillar stage is the one most commonly known to the strawberry grower. A full-grown larva is about ½ inch long and of a general deep green color. There are two broods of caterpillars per year and the second brood is found on blackberry and raspberry as well as on strawberry.

Control: If treatment is neglected until after the leaves are folded, nothing can be done in holding this pest in check. Since the time of appearance of the young larvæ depends largely upon the season, it is important that the grower keep close watch for the first young worms, and apply arsenate of lead, 3 pounds to 50 gallons of solution as soon as he notices them. The number of adults can be greatly reduced by mowing the infested patches after the fruit is taken off. This, combined with the spraying with arsenicals, will readily control this insect.

STRAWBERRY SAW-FLIES: There are two species of saw-fly larvæ or "worms" that skeletonize the leaves of strawberries in Indiana. In general appearance these larvæ resemble those of the currant saw-flies. The larvæ of one of these species is yellowish-green in color with a yellow head, on the side and top of which there are two brownish spots. The abdominal prolegs are also yellow. The larvæ of the other species are deep green in color. The head is decidedly brown and the body, which is much wrinkled, is marked with one dorsal and two lateral obscure blackish stripes. The larval period lasts from fourteen to sixteen days. The larvæ of both species when full-grown are about $\frac{3}{4}$ inch long. At this time, usually the first part of June, they enter the ground, where they spin a cocoon and remain till the following spring. The adults are typical saw-flies, $\frac{1}{4}$ inch long and resemble each other quite closely.



STRAWBERRY LEAF-ROLLER INJURY.

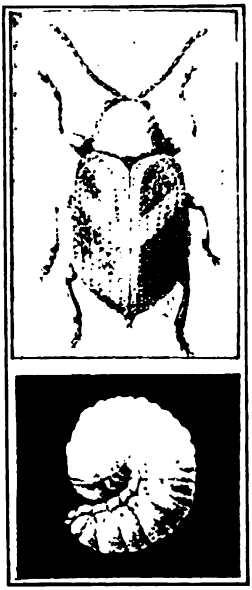
Control: The larvæ are readily killed by the use of an arsenical, for the application of which see strawberry leaf-roller.

STRAWBERRY CROWN-BORER: This insect is best known by its larva, which is a small white grub, working in the crown of the plant, girdling it so completely that the center may be readily pulled out. Affected plants are usually much stunted in growth or killed. This pest has done considerable damage in the strawberry fields in the vicinity of Borden, Indiana.

The adult is a curculio beetle about ⅛ inch long, with a brown head and darker thorax. Each wing cover is marked with three more or less well defined black spots on the edge.

Control: On account of the inability of this pest to fly—its wings being useless—it is rather readily controlled by plowing out and burning the plants from the infested fields. Therefore, using uninfested plants and locating the new patch as far as possible from the old one will keep this insect from getting a foothold.

STRAWBERRY ROOT WORMS: The root worms are the larvæ of three of the very common Chrysomelid or leaf-eating beetles in this State. These larvæ are readily distinguished from those of the crown-borer by the fact that they are much thicker, more curled, and have three pairs of legs on the thorax.



STRAWBERRY ROOT-WORM. (*Typophorus canellus*). Adult and larva, greatly enlarged.
(After Petitt, Mich. Exp. Sta.).

These three species, in the order of their economic importance, are known scientifically as *Typophorus canellus, Colaspis brunnea* and *Graphops pubescens*, and may be distinguished by the following descriptions of their habits and the appearance of the adults:

Typophorus canellus is an oval shaped beetle of a variable color. The colors of varieties of this species vary from black to reddish and yellowish, and the wing covers may bear from one to three spots. This beetle passes the winter as an adult and lays its eggs in the spring, the larvæ attacking the plants in June and July.

Colaspis brunnea is slightly larger than the preceding species and of the same general shape. Because of its general color, yellowish tinged with brown and reddish, this species is easily confused with some of the color varieties of the preceding. The larvæ of this species do their damage in

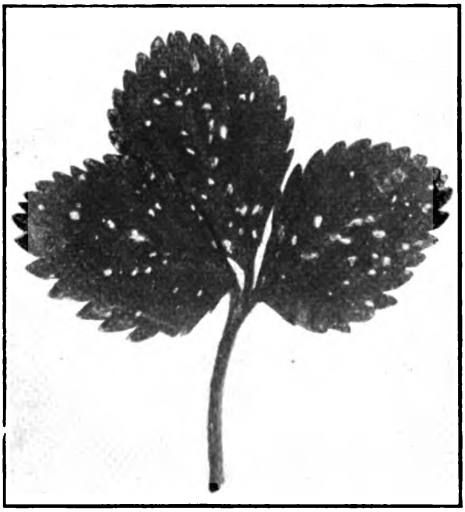
April and May, while the winter is probably passed in the egg stage.

Graphops pubescens is oblong in shape and more slender and cylindrical than either of the preceding species. It is little less than ⅛ inch in length, of a bronze color, and sparsely covered with pubescence. The adult beetles appear in May, the larvæ being the hibernating form. The eggs are laid in July and the larvæ attack the plants in August and September.

Control: The adults of all three insects are leaf feeders and may be controlled by spraying with 3 pounds of arsenate of lead to 50 gallons of water. Badly infested fields should be handled the same as those infested with crown-borers.

STRAWBERRY DISEASES.

LEAF SPOT: This disease is common throughout the State and attacks the leaves and fruit stems of its host. Leaf spot first appears on the leaves about flowering time as scattered, small, reddish or purplish spots. These increase in size and their centers become pale gray or white when the tissue dies, while the border is dull red or purple. In severe cases of infestation numerous spots coalesce and form large blotches. All cultivated and wild varieties are attacked though there is a great difference in their susceptibility.



STRAWBERRY LEAF SPOT.

Control: Only healthy plants should be set out and all leaves showing spots should be removed and burned. Spraying with Bordeaux in the spring before the blooming time is quite effective in controlling this disease. Mowing off and burning the leaves on the bed will help, to a large extent, in holding this disease in check.

POWDERY MILDEW: This mildew resembles the powdery mildew of grape and causes a curling and whitening of the leaves.

Control: Spraying with Bordeaux and burning voer the bed in the fall will control this disease, which as a rules does not prove serious in this State.

Spray Calendar for Strawberries.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
When growth has begun, just before blossoming.	Leaf-spot, Rust, Leaf-roller, Slugs, Beetles of Root-worms.	4-4-50 Bordeaux and 2½ pounds arsenate of lead paste to 50 gallons of solution.	After the fruit is all picked, patches should be mowed and when the weeds, etc., are dry, they should be burned over. A windy day should be chosen for this burning to make it rapid, thus avoiding injury to the crowns of the plants.
About every 2 weeks until the berries are from one-half to two-thirds grown.	Same as above.	Same as above.	On varieties particularly susceptible to Leaf Spot, and during years favorable to the spread of this disease, additional applications of Bordeaux are advised.

Spray Calendar for Potatoes.*

When to Spray.	What to Spray for.	Material to Use.	Remarks.
When the Colorado Potato-beetles appear or when the vines are 6 or 8 inches high.	Colorado Potato-beetles, Flea-beetles, Blister - beetles, Early and Late Blight.	Arsenate of lead paste, 3 pounds to 50 gallons of Bordeaux (Bordeaux 6-6-50.)	If no insects have appeared at the time the potatoes are 6 or 8 inches high, the arsenate of lead may be omitted from the first spray. The fungicide (Bordeaux) should be applied every two weeks during the growing period of the vines, and the arsenate of lead should be added whenever the biting insects are present.

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*The insects and diseases affecting tomatoes are generally similar to those on the potato and the grower will in most instances find it advisable to follow the same spray schedule for tomatoes as is recommended for potatoes.

SPRAY CALENDAR FOR POTATOES—Continued.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
At intervals of about 2 weeks throughout the growing period of the vines.	Same as above.	Same as above. (See Remarks.)	During moist, warm seasons it is advisable to spray with Bordeaux as often as every 10 days; but during dry weather the intervals between the applications may be extended to about 3 weeks.

Spraying will not control Fusarium and bacterial wilts.

Spray Calendar for Melons, Cucumbers, Etc.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
When the two seed leaves appear.	Striped Cucumber-beetle.	Arsenate of lead paste, 4 or 5 pounds to 50 gallons of water or tobacco dust.	Small domes of fine-mesh screen 8 or 10 inches in diameter are extensively used, and with good success. They serve to keep the insects from the vines until enough growth is made to better withstand their ravages.
When Melon Aphis appears.	Melon Aphis.	"Black-leaf 40," one part to five hundred parts of water, to which a soap sticker (4 pounds whale oil soap to 50 gallons of water) has been added.	Chip the soap and dissolve in hot water and then dilute to 50 gallons. Add the "Black-leaf 40" to this. The spray should be directed to the undersides of the leaves, and should be applied before curling takes place, as the solution must be thrown directly upon the bodies of the plant-lice.

SPRAY CALENDAR FOR MELONS, CUCUMBERS, ETC.—Continued.

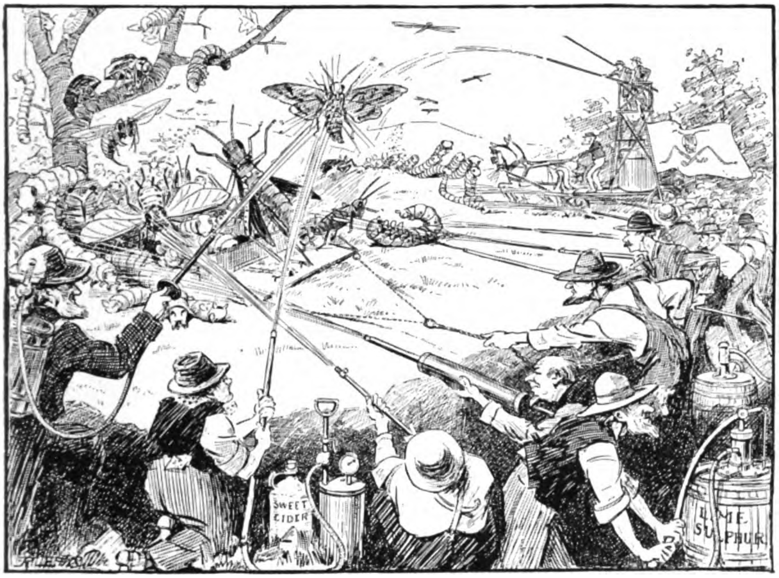
When to Spray.	What to Spray for.	Material to Use.	Remarks.
Begin at the time the plants start to vine and repeat every 2 or 3 weeks throughout the growing period.	Rust, Anthracnose, Mildew.	4-4-50 Bordeaux.	Arsenate of lead should be added to the Bordeaux whenever biting insects are present.

A bacterial disease of cucurbits causes a rapid wilting of the vines, and when affected plants are first observed they should be pulled out and destroyed. Crop rotation is a very important aid in the control of any of the insects and diseases affecting cucurbits.

Spray Calendar for Cabbage and Cauliflower.

When to Spray.	What to Spray for.	Material to Use.	Remarks.
At the time the cabbage "worms" appear, and every 10 or 15 days after this until the heads are about half-grown.	Cabbage "Worms."	Paris green ⅓ pound to 50 gallons of water, or arsenate of lead paste, 2 or 3 pounds to 50 gallons of water. (Use soap "sticker" as for Melon Aphis, in either case.)	Dusting with Paris green or powdered arsenate of lead have given good results.

If aphids are present and confined to a few plants, destroy the infested plants; but if a general infestation occurs, apply the control measures that are recommended for the control of melon aphis in the spray calender for melons,cucumbers, etc.



WAR IN INDIANA

COMBINATION SPRAY MIXTURES.

In the summer there are nearly always fungous troubles to fight at the same time insect pests must be combated, and it is therefore very economical to combine an insecticide with a fungicide. On account of chemical reactions there are several combinations that should not be attempted.

Tobacco extracts may be used in combination with arsenate of lead and with lime-sulphur, and they may be mixed with Bordeaux. Lime-sulphur solution should not be used in combination with any arsenical except arsenate of lead. Bordeaux may be mixed with Paris green or lead arsenate and it may be used in combination with arsenite of zinc.

INSECTICIDES.

Insecticides may be divided into four groups according to their function. The first group—contact insecticides—are those that kill by coming in contact with the insects. In spraying with a material of this sort, therefore, great care must be exercised to get the material directly on the insects. The next group—stomach poisons—are placed upon the food material of the insects and may precede the appearance of the particular pest for which they are applied and still be effective. The main point to be kept in mind in connection with the stomach poison is to get the poison spread thoroughly over the food material of the insect. The third group of insecticides may be called repellants, as they are not designed to kill the insects, but to keep them from their food plants. The last group of insecticides is the fumigants. The fumigants are handled in such a way as to produce a gas which is poisonous to insect life. This group of insecticides is used when a poisonous gas is needed to reach a secluded place where contact or any other insecticides would be impracticable. An inclosure, of course, is necessary in the use of hydrocyanic acid gas, but carbon bisulphide may be used in the fumigation of soil as the gas formed is much heavier than air and will penetrate through the soil if the latter is porous.

CONTACT INSECTICIDES.

No. 1. LIME-SULPHUR SOLUTION:

Lime	40 pounds
Sulphur	80 pounds
Water	50 gallons

In the manufacture of lime-sulphur solution high-grade stone lime should be used and it should be as free as possible from magnesium. It is impracticable for one to attempt to manufacture lime-sulphur if the lime to be used contains more than 5% magnesium. New process lime (sometimes called hydrated lime or powdered lime) may be used with good success, but it is not advisable to recommend it as there is danger of its being somewhat air-slaked The stone lime used should be absolutely free from air-slaked particles.

If stone lime comes in large lumps these should be broken up.

The lime should be placed in a kettle or container holding somewhat more than 50 gallons and covered over with enough warm water to start slaking. As soon as the lime begins to slake add the sulphur, which should have been previously made into a fine paste with hot water. The whole mixture should then be diluted to make 50 gallons and boiling should be continued for 45 minutes. The solution should be kept as nearly to the 50 gallon mark as possible during the entire cooking period. One should have a notched stick for measuring the quantity in the kettle. When boiling is going on vigorously throw a little cold water in to stop the cooking for an instant so that an accurate measurement may be made and the solution kept at 50 gallons.

Lime-sulphur solution can be made up in this way during the winter months or during odd times. Carefully strain the solution and place in barrels with the air excluded to prevent crystallization. The hydrometer should be used to determine the density of the material and whether it is used for dormant or summer spraying, it should be diluted according to the following table.

*TABLE FOR DILUTING LIME-SULPHUR SPRAY.

Density of Solution in degrees Beaume.	Sulphur in one gallon of solution.	(Dilution for San Jose Scale.) For 1 gallon Lime-Sulphur Solution. Use.	(Dilution for Summer Spray.) For 1 gallon Lime-Sulphur Solution. Use.
36	2.99 pounds.	9 gallons water.	45 gallons water.
35	2.88 pounds.	8¾ gallons water.	43¼ gallons water.
34	2.77 pounds.	8¼ gallons water.	41½ gallons water.
33	2.67 pounds.	8 gallons water.	40 gallons water.
32	2.53 pounds.	7½ gallons water.	37¾ gallons water.
31	2.43 pounds.	7¼ gallons water.	36¼ gallons water.
30	2.30 pounds.	6¾ gallons water.	34¼ gallons water.
29	2.20 pounds.	6½ gallons water.	32¾ gallons water.
28	2.08 pounds.	6 gallons water.	31 gallons water.
27	1.99 pounds.	5¾ gallons water.	29½ gallons water.
26	1.87 pounds.	5¼ gallons water.	27¾ gallons water.
25	1.76 pounds.	5 gallons water.	26 gallons water.
24	1.65 pounds.	4½ gallons water.	24¼ gallons water.
23	1.55 pounds.	4¼ gallons water.	22¾ gallons water.
22	1.45 pounds.	3¾ gallons water.	21¼ gallons water.
21	1.35 pounds.	3½ gallons water.	19¾ gallons water.
20	1.26 pounds.	3¼ gallons water.	18¼ gallons water.
19	1.18 pounds.	3 gallons water.	17 gallons water.
18	1.11 pounds.	2¾ gallons water.	16 gallons water.
17	1.04 pounds.	2½ gallons water.	15 gallons water.
16	0.97 pounds.	2¼ gallons water.	14 gallons water.
15	0.90 pounds.	2 gallons water.	12¾ gallons water.

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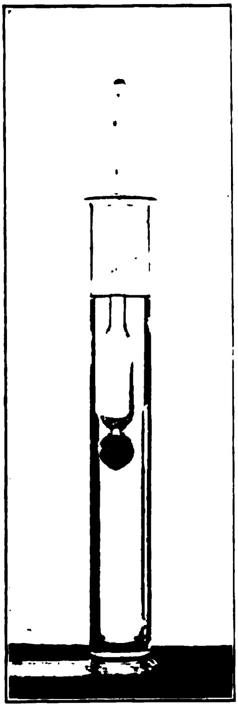
*Van Slyke, Bosworth and Hedges, N. Y. Sta. (Geneva), Bul. 329–438, 1911.

"Shall the fruit grower manufacture his own lime-sulphur?" This is a simple problem in arithmetic for the individual grower to solve for himself. His decision as to whether he should make his own or buy the commercially prepared product will depend upon the following factors: First, the cost of securing fresh stone lime with a guarantee from the producer that it contains at least 90% calcium oxide and not more than 5% magnesium oxide; second, the cost of the commercial solution; third, the cost and efficiency of labor; fourth, the cost of fuel for cooking and equipment, such as kettles, barrels or containers, and so forth; fifth, the comparison of the above factors with the price for which the commercial preparation may be obtained.



HYDROMETER USED IN TESTING LIME-SULPHUR SOLUTION. (Original.)

As a rule, the person having a small orchard or small number of trees will find it more economical to buy the lime-sulphur prepared. In several instances the commercial orchardist—in view of the foregoing factors—finds it is economical to buy a commercially prepared product as he is usually able to get a special price by buying in car load lots or in large quantities.

No. 2. KEROSENE EMULSION:

Soap	1 pound
Or Gold Dust	½ pound
Water	1 gallon
Kerosene	2 gallons

Dissolve soap in one gallon of soft water. Boil water to dissolve soap. When dissolved remove from the fire and add to 2 gallons kerosene. Agitate this mixture violently by forcing it through the spray pump and back into the vessel containing it, for five or ten minutes, until a thick white creamy liquid is formed with no drops of free oil on the surface. When completed, test with a piece of glass by inserting it into the emulsion and then drawing it out and looking for globules of unemulsified oil. If the oil is not completely emulsified it will injure the foliage. Dilute one part emulsion to from nine to fifteen parts of water according to the tenderness of the foliage and apply directly to insects.

This mixture is used in the summer control of scale insects while they are in the crawling stage. It is also used against plant-lice and has been effectively used in the control of mites.

No. 3. NICOTINE SULPHATE SOLUTION:

There are a number of concentrated tobacco extracts on the market, but those in which the nicotine is present in the form of a sulphate are the best because free nicotine vaporizes readily and extracts of nicotine lose their strength. One of the most stable and satisfactory of these compounds is "Black Leaf 40" which is manufactured by the Kentucky Tobacco Products Co., Louisville, Ky. Any of them should be diluted and applied according to the directions accompanying the package, and they are more effective when accompanied by "soap sticker" as described on the following page (No. 9).

No. 4. WHALE OIL SOAP:

Whale oil soap	1 pound
Water	6 gallons

This is used mostly against plant-lice, mealy bugs and other soft-bodied insects.

No. 5. TOBACCO TEA:

Tobacco stems or refuse from cigar factory	1 pound
Water	1 gallon

Steep as in making tea, but do not boil, since the nicotine which gives it an insecticidal value, is volatile and is lost to a great extent in boiling. Apply this "tea" without diluting.

No. 6. SULPHUR AND SOAP SOLUTION:

Sulphur	2 pounds
Soft soap	4 ounces
Water	4 gallons

This spray has been found quite effective in controlling mites such as red spider.

No. 7. FLOUR PASTE:

Flour	1 pound
Water	1 gallon

This paste is made by mixing a cheap brand of wheat flour with cold water to make a thin batter free from lumps. Better yet, is washing the flour through a wire screen with a stream of cold water. This is diluted until there is one pound of flour to a gallon of water. The dilute batter is cooked until a paste is formed. Care must be taken to prevent caking or burning. Water is added to make up for evaporation.

A solution containing 8 gallons of flour paste to 100 gallons of water has been found to be one of the most effective sprays against red spider. Four parts of paste may be used as a "sticker" in lime-sulphur solution diluted one to seventy. This also has been found a good remedy against red spider.

No. 8. POWDERED LIME:

This is often used in combating rose slugs, pear slugs and other insects that have sticky bodies. It should be dusted over the leaves.

No. 9. SOAP STICKER:

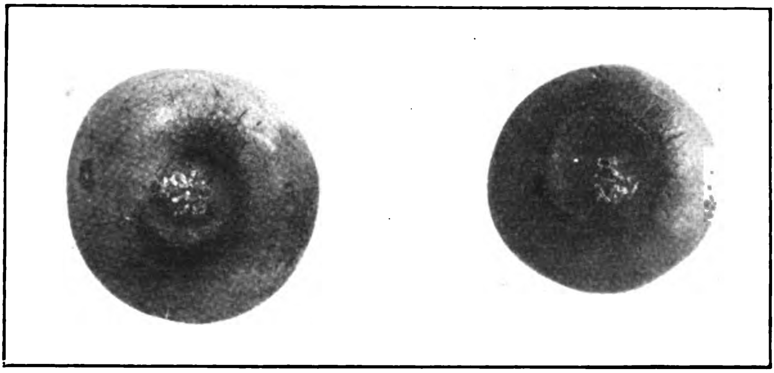
This is made by chipping 3 or 4 pounds of laundry soap in 2 or 3 gallons of hot water and adding this to each 50 gallons of the spray mixture, after the soap has been dissolved. This should be added as ordinary water to make up the mixture instead of being added after the mixture has been diluted to its strength.

Soap sticker should always be used when plants with waxy leaves, such as cabbage, are to be sprayed. Wherever arsenicals are to be used it is generally advisable to add soap sticker, for it has been found that soap solution prevents the settling out of arsenicals, i. e., it holds them in suspension and makes a more uniform mixture—a thing that does not always happen if the spray pump agitator is relied upon alone.

STOMACH POISONS.

No. 1. **ARSENATE OF LEAD:**

Arsenate of lead paste...............	2 to 4 pounds
Or Powdered arsenate of lead	1 to 2 pounds
Water................................	50 gallons



ARSENIC INJURY. (Original.)

Because it adheres better to the foliage and does not burn it as readily as Paris green and because it can be used in combination with lime-sulphur solution, arsenate of lead has in recent years displaced practically every other arsenical as a stomach poison. We know of no orchardist in this State who prepares his arsenate of lead, and believe that it is cheaper in the long run to buy a good commercial brand than to risk a home-made material. The amount of this substance to be used depends on the insect to be killed and the susceptibility of the foliage to which it is applied to arsenic injury. Wherever there is danger in burning the leaves or fruit with this poison it is advisable to add a pound of lime to each pound of lead arsenate paste used in order to neutralize any free arsenic it contains. When used in combination with Bordeaux mixture, or self-boiled lime-sulphur solution these act as the neutralizing agent, and it is unnecessary to add any extra lime.

No. 2. PARIS GREEN:

Paris green	1 pound
Quick lime	2 pounds
Water	200 gallons

When Paris green is used in spraying plants with waxy foliage, such as cabbage, three pounds of soft soap should be used to every 50 gallons of solution to serve as a "sticker." Paris green makes a good insecticide when used at the above rate but it cannot be used in combination with lime-sulphur solution and it sometimes burns the foliage badly.

REPELLANTS.

No. 1. TREE TANGLEFOOT:

This is a trade name of a sticky substance manufactured by O. & W. Thum Co., Grand Rapids, Michigan. It is used for banding trees to catch such insects as the wingless females of the tussock moth and canker worm moths and various caterpillars that migrate from tree to tree.

No. 2. CRUDE CARBOLIC SOAP PAINT:

This is made by the following formula:

Crude carbolic acid	1 pint
Thick soap paste	10 gallons

It is used as a repellant against fruit-tree bark-beetle, round-headed and flat-headed apple borer and peach-tree borer.

No. 3. WHITEWASH:

A thick whitewash to which about four pounds of salt to 50 gallons has been added is often used as a repellant for bark-beetles and borers. It should be applied at least three times a season in neighborhoods where these beetles are numerous. This wash is best applied with a whitewash brush or broom.

No. 4. CARBOLINEUM EMULSION:

Naptha soap	4 pounds
Water	4 gallons
Carbolineum avenarius	1 gallon

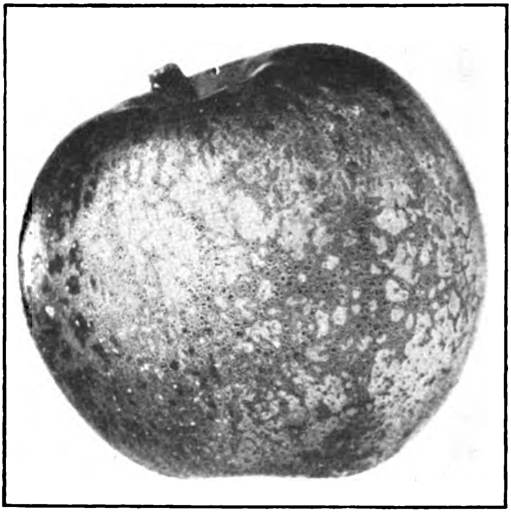
This wash has been recommended by Professor H. A. Gossard of the Ohio Experiment Station, as a repellant for bark-beetles and shot-hole borers. The directions for preparing it are as follows: The soap is dissolved in four gallons of hot water and while it is still boiling it is removed from the fire and the carbolineum is added and the whole agitated in the same manner as is kerosene emulsion (for which see page 177). After the mixture is well emulsified, 3 gallons of hot water are added to it, and the emulsion is sprayed on the trees while warm. The wash should be applied three times, about April 1st, the middle of July and about October 1st. Care should be taken not to apply the wash to the foliage, and as it is very penetrating and causes a sloughing of the skin, one should keep his face and hands well protected and the horses well blanketed when he is applying it.

FUNGICIDES.

No. 1. **BORDEAUX MIXTURE:**

Copper sulphate (blue vitriol) .... 4 pounds
Quicklime (not air-slaked) .... 4 pounds
Hydrate lime ¼ more.
Water to make 50 gallons.

The equipment should consist of a 50-gallon barrel, two 25-gallon tubs, a couple of buckets and a paddle. The tubs are placed one on each side of the barrel. In one, the four pounds of copper sulphate, in a coarse sack, are dissolved in ten gallons of hot water and diluted to 25 gallons. In the other tub the lime is slaked, only sufficient hot water being used to make it form, when thoroughly slaked, a thick paste. In this form the lime should be diluted to twenty-five gallons. The two solutions are then ready to be mixed, two persons being necessary for this operation. The contents of each tub are kept well stirred and a bucket each of milk of lime and sulphate solution are poured into the barrel simultaneously, care being taken to allow the two streams to come together. This process is continued till the entire amount is made. The blue mixture in the barrel is thoroughly agitated, strained through a thirty-mesh to the inch wire strainer, into the spray tank and

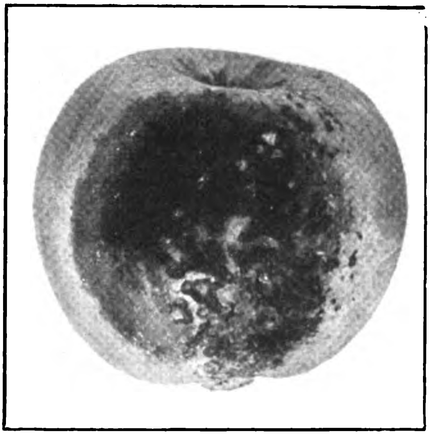


BORDEAUX INJURY.

applied. For such trees as are injured by the 4–4–50 formula a mixture of two pounds of copper sulphate, two pounds of quicklime and fifty gallons of water may be used.

COPPER SULPHATE STOCK SOLUTION AND LIME PASTE.

Where large amounts of Bordeaux mixture are to be made for several sprays much valuable time will be saved by having a stock of the materials. If no lime is added to it, a solution of copper sulphate that contains a pound of sulphate to each gallon of water may be made and if covered it can be allowed to stand indefinitely. From two to four gallons of this stock solution (according to the strength of Bordeaux mixture desired) is taken for each fifty gallons of the mixture to be made.



LIME-SULPHUR BURN. (Original.)

The lime should be slaked and kept in a long trough or box of uniform width. The proper amount of quicklime is weighed out, placed in the trough and slaked with a small quantity of water. The resulting paste is spread out evenly in the trough and covered with water to exclude air. Calculated portions of this paste are placed in a tub and treated like freshly slaked lime. It must be borne in mind that it is always better to combine the sulphate and milk of lime solutions diluted to volume rather than mixing the concentrated solutions.

The present very high cost of copper sulphate (blue vitriol or bluestone) makes spraying with Bordeaux mixture almost prohibitive, but there is no satisfactory and efficient substitute for it where its use has been recommended in the spray calendars.

No. 2. LIME-SULPHUR SOLUTION:

For directions for using both home-boiled and commercial lime-sulphur solution as a fungicide, see the dilution table under Insecticides.

No. 3. SELF-BOILED LIME-SULPHUR SOLUTION:

Stone lime	8 pounds
Sulphur	8 pounds
Water	50 gallons

This fungicide has become famous in the control of brown rot in stone fruits. It is especially valuable as a fungicide on peaches and Japanese varieties of plums because it does not injure the foliage. This mixture can be made in any quantity desired by using materials in proportion to the above formula.

The lime is placed in a barrel and enough water is added to barely cover it. Sulphur that has first been run through a sieve to break up the lumps is added as soon as the lime begins to slake. This mixture should be stirred constantly and water added to form first a thick and gradually a thin paste. The slaking of the lime supplies enough heat, and this with the constant stirring produces the desired mechanical mixture of lime and sulphur. After from five to fifteen minutes (depending upon whether the lime is quick-acting or sluggish) water is added to cool the mixture and prevent further cooking. The mixture should be strained into the spray tank (care being taken to work all the sulphur through the strainer), diluted at once, and applied. If allowed to stand too long before dilution the sulphur tends to unite with the lime, forming at the end of half an hour enough reddish liquid or regular lime-sulphur solution to seriously burn peach foliage and sometimes even apple foliage.

No. 4. AMMONIACAL COPPER CARBONATE:

Copper carbonate	5 ounces
Strong ammonia (26° Beaume)	3 pints
Water	50 gallons

This material is designed principally for use on fruit that is nearly ripe or on ornamental plants, as it does not leave discolorations, which are in the above instances objectionable.

Use a wooden pail for making a thick paste by adding water to copper carbonate. Dilute the ammonia with three or four parts of water, add to the copper carbonate paste and stir well. Add enough water to bring the quantity up to 50 gallons of mixture.

No. 5. CORROSIVE SUBLIMATE (*Mercuric Chloride*):

Corrosive sublimate	1 ounce
Water	7 gallons

This solution is one of the best wound antiseptics that can be used in swabbing pruning cuts, especially where such diseases as fire blight and blister canker are present in the orchard. (A solution of this strength is also effective in controlling potato scab and seed potatoes should be soaked in it for about one and one-half hours). Corrosive sublimate tablets are now being put on the market under such names as "Antiseptic Tablets" and "Diamond Antiseptics" and this is indeed a very convenient and desirable form in which to handle such a dangerous poison, as one tablet added to a pint of water makes the usual 1–1000 solution.

A solution of mercuric chloride should *never* be placed in a metal vessel.

Wound Dressings.

To prevent evaporation and also protect the wound from germs and fungi which cause decay it should be treated with a dressing. Ideal wound dressings should therefore possess at least three characteristics. In the first place they should be of a material that will prevent decay from starting in the wound; second, they should be of a nature that they will not injure the living tissue upon which they are applied; and third, their cost should be within the bounds of reason.

No. 1. WHITE LEAD PAINT:

This is perhaps the most economical and convenient form of wound dressing. White lead should be mixed with raw linseed oil to make a thick heavy paste that can be applied with a brush or swab. The wounds should be dry when it is applied and the paint should be well worked into the grain of the wood. Lamp black may be added to the paint to make its color about the same as that of the bark.

No. 2. GRAFTING WAX:

This material used as a wound dressing is very good and may be applied to cut surfaces, graft-unions or wounds of any sort.

The main objection to grafting wax as a wound dressing is its cost. For graft-unions, however, it is almost necessary. The following materials are used in making it:

Resin	4 pounds
Beeswax	2 pounds
Rendered beef tallow	1 pound

The following is the method for making grafting wax: Melt the resin and beeswax over a slow fire but do not boil it. Add the tallow and as soon as all is melted pour the entire mass into a bucket of cold water. Flatten out the whole mass with greased hands in order that it may cool uniformly. As soon as cool enough to handle take it from the bucket and work or pull it as one would in making taffy. The longer it is pulled, the better will be the quality. When completed, place in a cool location and use as desired. It will keep indefinitely. In cool weather it is advisable to have a bucket of warm water at hand when it is used to warm it up and make it more pliable. If used on wounds it will sometimes have to be replaced the second year, as it has a tendency to loosen.

No. 3. COAL TAR:

This material should be used sparingly on any kind of a tree and on account of the great danger of injury to the living tissue, it is not advisable to attempt its use upon any except shade and ornamental trees. Even with these trees, it would probably be much better to use some other sort of dressing.

No. 4. ASPHALTUM:

Asphaltum or mineral pitch with a high melting point has been used with very good results in several parts of the country and the future of this material as a wound dressing is promising. Either already prepared as a paint, or ordinary asphaltum, if it is cut with gasoline is a very good wound dressing.

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THE COCCIDAE
OR SCALE INSECTS
OF INDIANA

Office of State Entomologist
Indianapolis, Indiana
April, 1916

THE COCCIDAE OR SCALE INSECTS OF INDIANA

BY

HARRY F. DIETZ AND HAROLD MORRISON.*

DRAWINGS BY R. E. SNODGRASS.

INTRODUCTION.

It hardly seems necessary to discuss the very great economic importance of the scale insects, as a mere mention of such species as the San Jose scale and Oyster-shell scale will recall to almost any plant grower recollections of injured and dead trees and shrubs. When the danger of distributing injurious species on nursery stock is also taken into consideration, it becomes evident that the accurate determination of injurious and comparatively harmless species is important.

The following paper presents a systematic study of the species of Coccidae which have been found in Indiana. The material on which it is based has been accumulated mostly by the writers, although there were a few species preserved in the collection of the State Entomologist's Office. So far as we are aware no other collections have been made in the State. The number of species added to the list of those previously recorded from Indiana since active work was begun on this paper last fall indicates that we have by no means exhausted the possibilities of the subject. Aside from articles on the injurious species in various publications, there has been only one attempt to treat the group as a whole with regard to its occurrence in Indiana, that of Douglass in the Fourth Report of the Indiana State Entomologist. In this paper forty species are listed, eight of which were first found by one of the present writers during the summer preceding the publication of the paper. Subsequent to this paper of Douglass', in the Sixth Report of the State Entomologist, the writers added six species to the list already published. The present paper includes sixty-two valid species, while three of the species listed by Douglass have been reduced to synonyms.

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*The arrangement of authors' names is alphabetical and indicates neither seniority nor precedence.

While the descriptions and keys are based on technical characters, a field key, based on superficial characters, has been included for the benefit of those who may not have facilities for microscopic study or who are not well acquainted with the technical terms used in describing coccid structures. We have also included a brief discussion of what appear at the present time to be the best practices in the control of scale insects. On account of the special treatment necessary to prepare scale insects for study, an outline of this treatment has also been given.

Mr. R. E. Snodgrass made all of the drawings used, and we are greatly indebted to him, not only for their excellence but for many suggestions regarding anatomical and structural peculiarities of the different species. We are also indebted to Mr. J. G. Sanders for suggestions and assistance with the soft scales. Finally, we wish to thank Mr. F. N. Wallace, present State Entomologist, for his kindness in allowing us sufficient time to prepare the paper for this report.

ECONOMIC SPECIES AND THEIR CONTROL.

Out of the total number of species found in Indiana, the following lists give those which have been found in sufficient numbers and on such hosts as to make them important economically. The few really bad species are among the most serious and the most difficult to combat of the insect pests of the state, and have been responsible for more legislation and more propoganda on the control of injurious insects than any other group of economic species.

The following list includes those species which have been recorded as injurious on trees and plants growing out-of-doors, and subject to normal climatic conditions during the whole year:

Phenacoccus acericola (Woolly maple leaf scale).
Pulvinaria vitis (Cottony maple scale).
Lecanium corni (European fruit lecanium).
Toumeyella liriodendri (Yellow poplar scale).
Chionaspis americana (Scurfy scale of elm).
Chionaspis furfura (Scurfy scale).
Chionaspis pinifoliae (Pine scale).
Chionaspis salicis-nigrae (Scurfy scale of willow).
Aulacaspis rosae (Rose scale).
Aspidiotus ancylus (Putnam scale).
Aspidiotus perniciosus (San Jose scale).

Aspidiotus uvae (Grape scale).
Chrysomphalus obscurus (Obscure scale).
Lepidosaphes ulmi (Oyster-shell scale).

In addition to the above species, the following have been found in the State, but are not yet known to be of economic importance here, although elsewhere they are serious pests:

Gossyparia spuria (European elm scale).
Lecanium nigrofasciatum (Terrapin scale).
Aspidiotus forbesi (Forbes or Cherry scale).
Aspidiotus juglans-regiae (English Walnut scale).

Of the species listed here, the members of the genus *Chionaspis*, *Lepidosaphes ulmi*, and usually *Aulacaspis rosae* winter in the egg stage, while the remainder winter as more or less fully grown insects, at least so far as the life history is known.

CONTROL OF SPECIES FOUND OUT OF DOORS.

Control measures for scale insects may be grouped in two classes, fumigation, and spraying with contact insecticides.

Fumigation, while largely practiced in certain parts of the country for the control of scale pests on orchard trees, has not proven successful in Indiana and other parts of the east, except for the control of scales on nursery stock. For this purpose it is the only really satisfactory method of treatment of infested stock before it is sent out of the nursery. The requisites for successful fumigation are: a practically air-tight space large enough to contain the stock to be fumigated and easily opened for ventilation, and a supply of at least fairly pure chemicals. The chemicals required and the proportions in which they should be used for each 100 cu. ft. of air space are as follows:

Potassium cyanide	1 oz.
Commercial sulphuric acid	1 oz.
Water	3 oz.

As it is practically impossible at the present time to obtain satisfactory potassium cyanide, sodium cyanide (133% pure) may be substituted with equally satisfactory results. In this case, the amounts should be as follows for each 100 cu. ft. of air space:

Sodium cyanide (133% pure)	1 oz.
Commercial sulphuric acid	1½ oz.
Water	2 oz.

Nursery stock should be exposed to the cyanide gas for from 30 to 60 minutes, preferably for the longer period.

Of the large number of contact insecticides only a few standard sprays need be mentioned. Perhaps the best single spray material for the control of scale insects is the lime sulphur wash. There is a standard formula for the preparation of this mixture by the grower, but we are inclined to believe that it will nearly always pay to purchase concentrated lime sulphur solution from a reliable firm in preference to attempting its manufacture at home. The concentrated solution should be diluted 1 gallon to 7 gallons of water, and where the infestation is serious, applications should be made in the fall after the leaves are off, and again in the spring just before the buds begin to open. Special care should be taken to spray with great thoroughness as this material will not spread after it is put on the trees.

The miscible oils are next to the lime sulphur wash in importance, and in many cases have produced better results than lime sulphur, which at times seems almost wholly ineffective. These oils, such as "Scalecide", and others come in concentrated solutions which should be diluted at the rate of about 1 gallon of spray solution to 15 gallons of water, or if they are to be used for the treatment of old heavy infestations, at the rate of 1 gallon to 12 gallons of water. They possess the distinct advantage over lime sulphur of spreading after they are applied, and of penetrating into places which would not otherwise be reached. We believe that they will be preferable for checking a heavy infestation, although if possible, it would be advisable for the user to test a small amount of the brand he desires to use preliminary to spraying, in order to determine if injury will result from its application.

Where trees are in immediate danger of being killed by the attacks of scale insects, it is possible to check the injury by a summer spray of kerosene emulsion, containing from 12-15% kerosene. This must be made up carefully, and to be effective should be applied at a time when the tiny yellow crawlers are abundant. Probably two or more applications about three days apart will produce better results, although the necessity for a second spray may be determined by an examination to ascertain the number of crawlers present after treatment.

The following list includes those species which we have found to be particularly injurious to greenhouse plants or to those grown indoors.

Eriococcus azaleae (The Azalea bark louse).
Pseudococcus adonidum (Long-tailed mealy bug).
Pseudococcus citri (Short-tailed mealy bug).
Coccus hesperidum (The soft scale).
Saissetia hemisphaerica (Hemispherical scale).
Saissetia oleae (Black scale).
Diaspis boisduvalii.
Hemichionaspis aspidistrae (Boston fern scale).
Aspidiotus hederae (Oleander scale).
Aspidiotus rapax (Greedy scale).
Aspidiotus britannicus.
Chrysomphalus aonidum (Circular scale).
Chrysomphalus dictyospermi (Morgan scale).

CONTROL OF GREENHOUSE SPECIES.

There are four difficulties to be overcome in the control of greenhouse species. These are:

1. The modern construction of long open ranges in which a large variety of plants are grown. This makes fumigation impossible owing to the varying susceptibility of different plants to hydrocyanic acid gas.
2. Florists who employ several men state that they are adverse to the use of this fumigant because of its deadly character and the danger of some one entering the house while fumigation is going on.
3. Florists are adverse to building a fumigation house because some plants most commonly infested with coccids such as coleus, etc., are also most easily injured by hydrocyanic acid gas. Then, too, moving plants to and from the fumigation house entails a great amount of labor.
4. Sprays that will kill the coccids will also damage the plants.

In the spring of 1915 a series of experiments was carried on by Mr. Dietz for the Office of the State Entomologist. The following mixtures were tried: Lime Sulphur 1-10, 1-15, 1-20; Fish Oil Emulsion; Kerosene Emulsion; Raw Linseed Oil Emulsion; Cotton Seed Oil Emulsion; "Black Leaf 40" and soap; Whale Oil Soap.

The results obtained with *Chrysomphalus aonidum* on *Kentia* (palms) were as follows: Lime Sulphur even at 1-10 did not kill more than 50% of the insects, adults and larvae. "Black Leaf

40", 1-200, with 4 lbs. of soap to each 50 gallons of solution did not kill any of the adults and very few of the larvae that had secreted a waxy covering. Raw Linseed Oil Emulsion made according to the following formula: Laundry soap 1 lb.; Raw Linseed Oil 1 gallon; Water 10 gallons; killed 100% of the scales, but after three weeks caused injury due to the drying of the oil on the leaves and the suffocation of the plant. Kerosene Emulsion carefully prepared according to the regular formula (Soap 1 lb.; Kerosene 2 gallons; water 1 gallon) and diluted 1 to 10 did not kill more than 30% of the insects and did considerable leaf injury to *Kentia*. Fish Oil Emulsion and Cottonseed Oil Emulsion prepared according to the formula given for the Raw Linseed Oil Emulsion killed 100% of the insects and did no injury to the plants. Whale Oil Soap 1 lb. to 2 gallons of water killed 99% of the insects and did no injury.

In the control of *Pseudococcus citri* and *adonidum* on *Ficus pandurata* the oil emulsions were very effective, and did no injury (except Kerosene) to the plants. However, in the control of these mealy bugs on coleus "Black leaf 40" 1-400, with soap 4 pounds to every 50 gallons of solution was the only remedy that could safely be used. Carefully and thoroughly applied it will kill all insects that are covered with it.

"Blackleaf 40" 1-200, with 4 pounds of soap to 50 gallons of the mixture was ineffective in the control of *Coccus hesperidum*, but Whale Oil Soap and the oil emulsions with the exception of Kerosene and Linseed Oil gave satisfactory results in the control of this pest.

As yet, no satisfactory method of control, except cutting off and burning infested fronds, has been found for *Hemichionaspis aspidistrae* on ferns.

There is one objection that florists raise against spraying for the control of scale insects (especially the Diaspinae) on palms, namely that the insects do not wash or rub off immediately after they have been killed and the plant thus remains as unsightly as before. However, it is only a matter of a few weeks if plants are syringed with a strong stream of water until all dead insects have "sloughed off". Most florists spend much time and labor scrubbing the insects off of the leaves with soap and water applied with a small brush. From the spraying experiments with "Blackleaf 40" cited above, it can be inferred that soap used at the rate of 1 pound to 12 gallons is ineffective in the control of armored scales. Hence unless florists use soap at the equivalent of Whale Oil

Soap solution, there is little hope of any insects being killed unless they are rubbed loose. Thus insects in crevices that are not readily reached when the plant is scrubbed serve only as a source of re-infestation. To overcome this, we would advise florists to use Whale Oil Soap 1 pound to 2 gallons of water, which saves the trouble of making emulsions, and as is shown above kills all insects coming in contact with the solution.

For the spraying of palms or any of the more resistant greenhouse plants we advise either the Whale Oil Soap diluted as for scrubbing, or Fish Oil or Cottonseed Oil Emulsion made according to the following formula: Oil 1 gallon; Soap 1 pound; Water 10 gallons.

For the control of mealy bugs "Black Leaf 40" or any reliable nicotine sulphate 1-400, and soap at the rate of 4 pounds to 50 gallons is the best remedy as we have been unable to do injury to the tenderest plants and have killed all the insects when the work was thoroughly done.

FIELD KEY TO THE SPECIES OF SCALE INSECTS FOUND IN INDIANA.

The following tables are based on such superficial characters as may be observed by the naked eye or with the aid of a hand lens. They are in no way to be relied upon for accurate determination of specimens, as the characters used, particularly in *Aspidiotus* and *Chrysomphalus*, are often too variable and indefinite to be satisfactory. It is hoped, however, that they will be of some use to field men in inspection work and to others who do not have laboratory facilities available.

A. Body of adult female small, flat, covered by an easily detached waxy scale; without legs or antennae . . . . *Diaspinae*
  B. Scale of female elongate, narrowed at cephalic end, exuviae terminal.
    C. Scale of female white; scale of male small, elongate, sides nearly parallel, white, felted, usually carinated.
      D. Scale of male not carinated; on sycamore, etc...*Chionaspis ortholobis*
      DD. Scale of male distinctly carinated.
        E. Found only on pine and other conifers . . *Chionaspis pinifoliae* (The pine scale.)
        EE. Not found on conifers. *Chionaspis* (6 species), *Phenacaspis* (2 species)
    CC. Scale of female brown, not white.
      D. Scale of female light brown; scale of male as in C; greenhouse species on ferns, etc . . . . *Hemichionaspis aspidistrae* (The Boston fern scale.)

DD. Scale of female usually dark brown; scale of male similar to that of female, but smaller and with a distinct hinge-like stricture on its apical third .... *Lepidosaphes*

E. Found only on imported citrus fruits in markets, groceries, etc.......................... *Lepidosaphes beckii* and *gloverii* (Purple scale) (Glover scale.)

EE. Found out-of-doors on a wide variety of hosts (The Oyster-shell scale) .... *Lepidosaphes ulmi*

BB. Scale of female circular to oval, exuviae central to marginal.

C. Scale of male small, elongate, parallel-sided.

D. Scale of male white, tricarinate.

E. Exuviae nearly central; greenhouse species. *Diaspis boisduvalii*

EE. Exuviae submarginal to marginal; normally found only out-of-doors (The Rose scale) .... *Aulacaspis rosae*

DD. Scale of male light but not white, not carinated; scale of female circular to oval, exuviae marginal; greenhouse species on palms, etc. (Chaff scale) .... *Parlatoria proteus pergandei*

CC. Scale of male similar to that of female or more oval .... *Aspidiotus* and *Chrysomphalus*

D. Greenhouse species.

E. Most of scale dark brown or black.. *Chrysomphalus aonidum* (Circular scale)

EE. Scale lighter.

F. Scale of female very convex.

G. Exuviae marked by dot and ring.... *Aspidiotus rapax* (The Greedy scale)

GG. Exuviae not so marked; large, elliptical .... *Aspidiotus latanіae*

FF. Scale flat or slightly convex.

G. Exuviae central, nipple-like; color of scale light gray, translucent, revealing orange or reddish insect beneath. (Red or orange scale)........... *Chrysomphalus aurantii*

GG. Exuviae not nipple-like, without dot and ring.

H. Color of scale grayish or dirty white................ ... *Aspidiotus hederae* and *Chrysomphalus dictyospermi* (Oleander scale) (Morgan scale)

HH. Color of scale light reddish brown, exuviae yellow to dull orange........ *Aspidiotus britannicus* and *cyanophylli*

DD. Species found out-of-doors.

E. Exuviae, when exposed, jet black; size large .... (Obscure scale)................. *Chrysomphalus obscurus*

EE. Exuviae paler.

F. Very flat, thin, pale, often oval or irregular in outline; found on underside of maple leaves . *Aspidiotus comstocki* (Comstock scale)

FF. Not so.

G. Exuviae central, pale yellowish when exposed, scale not very convex; half grown forms nearly black and showing a distinct central nipple surrounded by a depressed ring, this often persisting in the adult (The San Jose scale) .... *Aspidiotus perniciosus*

GG. Half grown forms not showing ring and dot arrangement, exuviae usually subcentral.

H. Most of scale dirty gray or darker; diameter about 2mm.; exuviae orange to brick red.

I. Exuviae orange when exposed; thus far found only on cherry in Indiana (Forbes scale). . *Aspidiotus forbesi*

II. Exuviae brick red when exposed; common on maples, etc. (Putnam scale). . . . . *Aspidiotus ancylus*

HH. Color of scale lighter or size larger.

I. Exuviae when exposed, reddish or orange brown; size large, about 3mm.; flat, color light grayish (English walnut scale). . . . . *Aspidiotus juglans-regiae*

II. Exuviae when exposed, light yellow or orange yellow; size smaller, not much over 2mm.

J. Center of scale white; on grape and sycamore (The grape scale). *Aspidiotus uvae*

JJ. Scale unicolorous; on elm. . . . . . *Aspidiotus ulmi*

AA. Body of adult female sac-like, gall-like, etc., not flat and covered by a detachable scale as are the Diaspinae, sometimes enclosed in a sac or covered with waxy or powdery secretion.

B. Greenhouse species.

C. Legs long, prominent; caudal end of body with a group of elongate white wax lamellae often longer than the body; the bare dorsal surface of the body olive green; on *Coleus*, etc. (The greenhouse Orthezia). . . . . *Orthezia insignis*

CC. Not so; legs shorter, no wax lamellae.

D. Adult female completely enclosed in a rough white waxy sac; color bright red; on Azaleas. . . . . *Eriococcus azaleae*

DD. Adult female not enclosed in a sac, although often covered with a white waxy secretion.

E. Adult female more or less coated dorsally with a white mealy secretion, margins of body with protruding white waxy filaments. . . . . *Pseudococcus*

F. Dorsum with stout pyramidal white waxy elevations; marginal wax plates short and stout, at most finger-like; body broad oval. . . . . *Pseudococcus pseudonipae*

FF. Dorsum not so heavily coated with wax, this not elevated, marginal filaments longer and more slender.

G. The four marginal filaments at hind end of body about as long as body. (Long-tailed mealy bug). . . *Ps. adonidum*

GG. None of the marginal filaments nearly as long as the body (Short-tailed mealy bug). . . . . *Pseudococcus citri*

EE. Body not coated with white mealy secretion; hind end of body with a cleft.

F. Mature female with a white ovisac much longer than its body; on *Acalypha*. . . . . *Pulvinaria floccifera*

FF. Female not secreting an ovisac.

G. Body very flat; shape oval, often irregular; anal cleft long; dark brown; body marked off into plate-like areas; on palms (The tessellated scale). . . . *Eucalymnatus tessellatus*

GG. Body at least a little more convex; anal cleft short; body not tessellated.

H. Body slightly convex, usually light in color . . *Coccus*

I. Shape oval (Soft scale) . . . . *Coccus hesperidum*

II. Shape more elongate . . . . *Coccus elongatus*

HH. Body strongly convex, nearly hemispherical.

I. Dorsum with a distinct H-shaped mark formed by ridges; color very dark brown, almost black (Black scale) . . . . *Saissetia oleae*

II. Dorsum smooth, hemispherical, color lighter. (Hemispherical scale) . . . . *Saissetia hemisphaerica*

BB. Species found out-of-doors.

C. Body dorsally naked, but surrounded laterally and ventrally by a firm sac; color dark reddish brown (European elm scale) . . . . *Gossyparia spuria*

CC. Body naked or covered with mealy secretion, not surrounded or enclosed in a sac.

D. Body more or less covered with mealy secretion, margins with projecting white waxy filaments . . . *Pseudococcus* and *Phenacoccus*

E. On the undersides of maple leaves (Woolly maple leaf scale) . . . . *Phenacoccus acericola*

EE. On the bark of sycamore . . . . *Pseudococcus trifolii*

DD. Body naked or with only a few tufts of dorsal white secretion.

E. Form not globular, or if approaching this shape color reddish brown; hind end of body with an anal cleft.

F. Mature female secreting a white wax ovisac . . . . *Pulvinaria*

G. Ovisac much longer than body, this with white wax secretion beneath; adults on leaves of maples (The cottony maple leaf scale) . . . . *Pulvinaria acericola*

GG. Ovisac shorter and stouter, body without wax secretion beneath; adults on twigs of maples, etc. (The cottony maple scale) . . . . *Pulvinaria vitis*

FF. Mature female not secreting an ovisac. Lecaniums, sens. lat.

G. Size very large, 10-13mm . . . . *Lecanium caryae*

GG. Size smaller, not over 8mm.

H. Found on Arbor-vitae . . . . *Lecanium fletcheri*

HH. Not found on coniferous hosts.

I. Adult female before oviposition pink in color, oval; on magnolia . . . . *Neolecanium cornuparvum*

II. Adult female usually more circular in outline; never pink in color, darker.

J. Fresh specimens yellowish mottled with darker color; on yellow poplar (Yellow poplar scale) . . . . *Toumeyella liriodendri*

JJ. Adult specimens in any condition some shade of reddish brown.

K. More oval, dorsum with two distinct humps; found only on *Crataegus* imported from Europe . . . . *Lecanium bituberculatum*

KK. Without humps.

L. Very convex, approaching globular; size medium; reddish brown, usually with a median darker dorsal mark; found on oaks (Oak lecanium) .... *Lecanium quercifex*

LL. Less convex.

M. Size small, hemispherical, smooth, with dark markings around the margin .... *Lecanium nigrofasciatum* (Terrapin scale)

MM. Size medium, color usually uniform reddish brown (European fruit lecanium) .... *Lecanium corni*

EE. Form very globular, closely resembling some Cynipid galls; without an anal cleft; color light mottled with darker, and with tiny black dots; occurring only on oaks .... *Kermes*

F. Scale very convex, approaching conical in form; segmentation indicated by three to five dark lines .... *andrei*

FF. Scale globular or nearly so, or broader than long.

G. Insect globular or nearly so.

H. Small (3-3.5mm.), covered with fine pubescence.... .... *pubescens*

HH. Size larger, not pubescent.

I. Longer than broad, with pale mid-dorsal line... *kingii*

II. Globular, pale bands transverse .... *galliformis*

GG. Broader than long, with median longitudinal constriction.. *pettiti*.

COLLECTING AND PRESERVING COCCIDÆ.

The chief requisite for a collector of coccids is keen observation. On the leaves, branches and trunks of the shade trees of cities and towns several species of economic importance may readily be found, and an hour or two spent in a large greenhouse where a wide variety of plants are grown should reveal at least half a dozen species. The best plan for the beginner in this work to follow is to list species that he has not found, together with the host plants on which they occur and then to watch such plants closely. The only utensils necessary in collecting are a sharp, strong bladed knife, a good pair of pruning shears, a botanist's vasculum (in the absence of which a large basket will do) and a number of paper sacks, of different size, such as are used by grocers. It is best, where practical, to put only a single species from a given host in a given place in a sack. The name of the host and the locality should be written on the sack.

Material brought into laboratory from the field is usually best preserved by drying. Specimens on the leaves and smaller stems may be placed between newspapers (that have been crumbled and smoothed out again, to make them soft) or blotters, and dried under very light pressure. Care must be taken to have at least two or three blotters or papers between each lot of material to prevent molding. Instead of blotters, heavy builders' paper, cut to size, is desirable because of its cheapness. Material on bark and the larger stems should be cut to the size of the container in which it is to go after it is dried, placed loosely in cardboard trays (empty spool boxes, etc.) and put into a tight dry drawer or other receptacle that can be fumigated. Care must be taken that book lice or mice do not get into this receptacle and destroy the material. It is also advisable to fumigate this material to kill the larvae of the scales.

After the material has been thoroughly dried it should be put into capsule boxes of uniform size. A thin layer of cotton should be placed on the bottom of the box, and then covered with a piece of soft tissue paper cut long enough to cover the coccid material after it has been put into the box. The box should then be labeled with the name of the genus and species, the host, the date, the locality and the collector on the top and the name of the genus and species on the end and side. We have found that boxes 3¼x2x7-8 inches are desirable since they can readily be filed on end in 4x6 card board filing boxes.

If one desires to have an exhibition collection, a piece of the host plant well covered with typical specimens of the insects can be placed in a glass vial. For this purpose, wide-mouthed shell vials should be used. The most useful size is about 8.5 cm. long and 3 cm. in diameter. A wad of cotton is placed in the bottom of the vial and the specimen with a complete record of its host, etc., is then inserted after which another wad of cotton to hold the specimen firm and the cork are put in. A label giving name, distribution, host, etc., may be pasted on the outside of the bottle opposite one of the cotton wads, preferably the lower.

It is inadvisable to preserve coccid material *in situ* in alcohol. The writers have experienced much trouble in clearing such material even in potassium hydroxide and acetic acid. If one wishes to keep material in alcohol it is better to remove it from the host plant and kill it in the following solution (Carnoy's Killing Solution) as for histologic purposes: Glacial acetic acid, 1 part; Absolute alcohol, 6 parts; Choloroform, 3 parts; Corrosive sublimate, to saturation. Material should be left in this solution for four or more hours. Fixation is more thorough and rapid if the insects are punctured. Material killed in this way should be washed in three changes of 70% alcohol and kept in 80% alcohol.

METHODS OF STUDY.

In beginning a study of the Coccidae one must bear in mind that the characters of taxonomic value are microscopic. This means that these insects must be specially prepared for study under the microscope. Although much has been written about methods for preparing coccids for study, practically all the work to date is more or less incomplete. When work on this paper was first begun, the writers had much difficulty in getting uniform results from the regular methods of preparation as set forth by Sanders, Herrick, Miss Palmer and others. Among the chief difficulties were getting the insects too clear or not clear enough. To overcome such troubles and to obtain uniform results considerable time was devoted to experimentation with "methods".

Mounts for the microscopic examination of the coccids are of two sorts, namely, temporary and permanent. We have found temporary mounts exceedingly useful in determining fresh material of the Diaspinae, the identification of very few species of which should be risked on gross characters, or in studying parts of the unarmoured scales for drawing. For making temporary mounts of Diaspinae the following procedure is used:

(1) Remove the insects from beneath their waxy covering. This should be done with a fine pointed dissecting needle under a binocular microscope if this is available. A dissecting microscope or a reading glass, mounted so that one can work under it, proves satisfactory.

(2) Place the insects in a drop or two of acetic-glycerine (made by mixing 90 cc. of melted glycerine jelly and 10 cc. of glacial acetic acid). Put a cover glass on this and heat the slide gently over an alcohol lamp until the acetic-glycerine begins to boil. Care must be taken so that this boiling is not too violent, as the glycerine is apt to dry out, and the point of a forceps or dissecting needle should be pressed on the cover glass during this process to prevent the insects from coming beyond its margin.

Specimens treated by this method show the marginal characters of the pygidium (plates, gland spines and lobes) nicely, but such characters as the dorsal gland openings are sometimes not clearly brought out. The advantages of this method are its simplicity and the rapidity with which it can be carried out. The chief disadvantage is the lack of neatness in the slides. Acetic glycerine mounts may be kept indefinitely if not put on edge, or the cover glass may be sealed down with a ring of Canada balsam and the mount thus be made permanent. If the specimens are valuable, it is advisable to carefully remove them from acetic-glycerine, wash for at least five minutes in two changes of distilled water, and treat according to the method given for making permanent mounts.

In studying the unarmored scales, we have found the following methods advantageous:

(1) Boil in a saturated solution of potassium hydroxide (caustic potash) until a greater part of the waxy secretions and body fats (Dactylopiinae) and the derm color (Coccinae) has been removed. For this operation a test-tube, a porcelain crucible or a small porcelain casserole, not more than 2 inches in diameter, may be used.

(2) Wash in distilled water for five minutes.

(3) Dissect out parts wanted for study, under a binocular or dissecting microscope. This should be done under water.

(4) Mount these parts directly in acetic-glycerine. Do not boil.

Mr. R. E. Snodgrass, who made the drawings for this paper, found that just boiling the Coccinae in water for few mintes and examining them in this medium either *in toto*, or in part mounted under a cover glass was an excellent way for preparing the derm for the examination of the pores. Where trouble was experienced in preparing material showing the marginal and spiracular spines, he obtained good results by boiling the insects *in situ* either in a very weak solution of potassium hydroxide or in water.

There are at least seven or eight steps in the preparation of permanent mounts of Coccidae for microscopic study, depending on the procedure used. These steps are:

(1) Removing the insects from the host plant and from beneath the waxy scale covering (Diaspinae). See methods for making acetic-glycerine mounts for this operation.

(2) Removing waxes, body fats, and derm color: For this purpose use potassium hydroxide (caustic potash). Leave material standing in a cold solution until transparent (longer than two days is a waste of time) or boil from five minutes to half an hour in this solution, in a crucible, porcelain casserole or test-tube. Diaspines become very transparent in this time, but many of the unarmored scales will not clear completely even after pro-

longed and violent boiling. To overcome this trouble, boil the insects in hydroxide for from five to fifteen minutes after which time puncture them with a fine dissecting needle and carefully press them to remove eggs and body contents, then transfer to a 70% or 80% solution of glacial acetic acid (made by adding 30 or 20 parts respectively of distilled water to 70 or 80 parts of glacial acetic acid). In boiling insects in a porcelain crucible or casserole, a ring stand or tripod with a pipe-stem triangle is desirable.

(3) Washing: Transfer insects from the hydroxide or acetic acid to distilled water. Leave from five to fifteen minutes depending on size and amount of material. Change water and leave insects at least 10 minutes longer. Never use tap water as it often contains substances, such as iron, which cause deposits on the specimens. For a utensil in which to wash and dehydrate, especially large amounts of material or species of large size, we have found Syracuse watch glasses useful.

(4) Dehydrating: From water transfer material to 95% alcohol. Leave in this solution at least ten minutes. Specimens of the Dactylopiinae often collapse when transferred and trouble is often experienced in transfering Diaspinae. To overcome this difficulty we have transferred the insects on the tip of a match stick which has been shaved off on two sides to make a long wedge-shaped blade. Take care that there are no free fibers or ragged edges on which insects may become entangled. It is desirable to use a different match stick for each reagent.

If the stain to be used is Picro-creosote, transfer material to absolute alcohol and leave at least ten minutes before putting into stain. If alcoholic stains (Magenta and Gentain Violet) are used, transfer material to these from 95% alcohol.

(5) Staining: For the best results in studying coccids the use of stains is necessary. Just what stain to use depends on the characters one desires to bring out. The stains given below were used with success. The utensil we have found most useful for this process is a covered porcelain palette with twenty-two concavities. This permits the staining of a number of different lots of material at the same time. During the process of staining it is advisable not only to keep the cover on the palette but to cover the concavities with a thin glass slide or plate to prevent the evaporation of the reagent.

Magenta Red or Acid Fuchsin: This reagent is prepared according to the following formula: Magenta .5 gm.; 95% alcohol

100 cc. Magenta is mentioned by Newstead and Stafford but no formula is given for its preparation. Doubtless good results can be obtained with a wide range of formulae under different treatment. With the above formula the writers have obtained excellent results by leaving Diaspinae in it from twenty-four to forty-eight hours. With material that has previously been treated with acetic-glycerine care must be taken to avoid overstaining. In staining unarmored scales, especially the Coccinae, we have found that if the anal ring and plates are the characters desired, material should be left in this stain twenty-four to forty-eight hours. If the derm pores are wanted, specimens should be left in stain from seventy-two to one hundred or more hours.

Gentain Violet: This stain was prepared according to the formula given above for Magenta. The time for leaving material in this stain and the results obtained from its use were about the same as those given under Magenta. One serious objection to the use of this stain, especially for Diaspinae, is that it is practically impossible to find material after it has been placed in it unless the stain is diluted with copious amounts of 95% alcohol just before the specimens are to be removed from it.

Picro-creosote: This stain was recommended by Brain for the armored scales. The following formula was tried by us: Picric acid, 1 gm.; Beechwood creosote, 100 cc. Theoretically this is an ideal stain, as it clears and stains at the same time. However, for staining Diaspinae it does not equal Acid Fuchsin and has the added objection that small specimens are exceedingly hard to find after being placed in it. The writers have also failed to get good results with this reagent in staining the derm pores of the Coccinae. The chief use of Picro-creosote is in staining the anal plates and ring of the Coccinae and the anal ring of the Dactylopiinae. For this purpose it was better than either of the alcoholic stains, as it imparted a very clear yellow color to these parts without overstaining them. The time required for this stain to act was seventy-two to one hundred hours.

(6) Removing excess stain and dehydrating: This step is unnecessary where specimens have been stained in Picro-creosote (See No. 7). For removing excess stain such as Acid Fuchsin or Gentain Violet, 95% alcohol is usually sufficient. In case specimens are deeply overstained, place them in the following solution: Hydrochloric acid, 1 cc.; 95% alcohol 100 cc., for a few minutes and then in two changes of 95% alcohol for at least fifteen min-

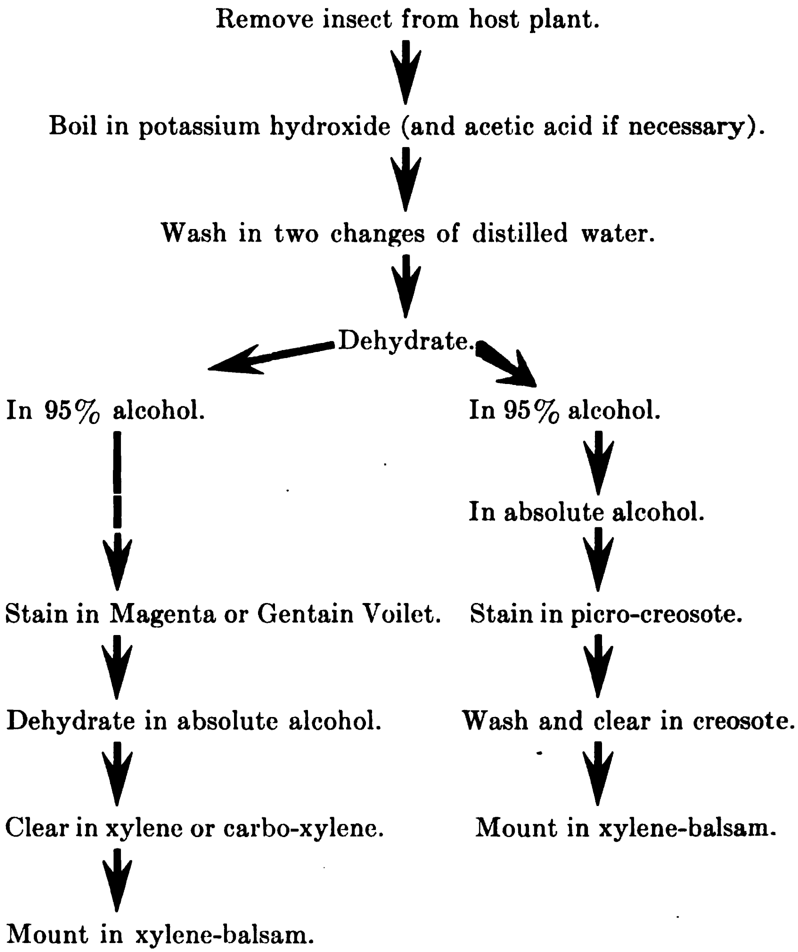
utes each. From the 95% alcohol transfer material to absolute alcohol and allow it to remain in this reagent at least ten minutes.

(7) Clearing: Transfer material stained with Picro-creosote to Beechwood creosote to clear and to remove surplus stain. Clear material stained in alcoholic stains either in xylene or carbo-xylene. The latter is made by adding 25 cc. of melted crystalline carbolic acid (phenol) to 75 cc. of xylene. This clearer has an advantage over xylene alone in that it acts as a dehydrating agent as well as a clearer and does not cloud material as xylene does when even the least bit of water remains.

(8) Mounting: In mounting the Diaspinae and Dactylopiinae place a drop of xylene in the middle of a slide and transfer a single specimen to it. Carefully absorb as much of the xylene as possible and place a drop of xylene-balsam over the specimen after which put on a cover glass and the mount is done. The slides used should be 75x25 mm. (3x1 inches) and the cover glasses No. 1 (the thinnest) 12 mm. (½ inch) circular. The xylene-balsam should have the consistency of a rather thin cane syrup.

In preparing the convex Lecaniums, the writers have made two sorts of mounts, in the first of which the insect was flattened out by pressure on the cover glass after the body margin had been cut at one or more points. We have found it desirable at times to dissect out the anal plates and ring in balsam before the cover glass is put on and to mount these separately though on the same slide. The second type of slide was one in which the specimen was mounted so as to preserve its form. This was done by first building two or three supports, high enough so that when the specimen is placed between these the cover glass does not press on it. These supports were made of bits of broken slides of varying thickness, saved for this purpose, stuck together with balsam and allowed to dry for a few minutes. The specimen is then placed between the supports in a small amount of balsam. The cover glass is then laid on the supports and balsam is floated in until the space beneath the cover glass is filled. The slide is then put away for several days to dry or if one is in a hurry, placed in a moderately warm oven for several hours. There are two objections to this type of slide. The first is that it cannot be used under the higher powers of the compound microscope, the second that slides lack neatness. However, we have found this type of mount very useful in showing the relation of parts to each other.

The following diagram illustrates the procedure used in making permanent mounts of coccids.



Remove insect from host plant.

Boil in potassium hydroxide (and acetic acid if necessary).

Wash in two changes of distilled water.

Dehydrate.

In 95% alcohol.

Stain in Magenta or Gentain Voilet.

Dehydrate in absolute alcohol.

Clear in xylene or carbo-xylene.

Mount in xylene-balsam.

In 95% alcohol.

In absolute alcohol.

Stain in picro-creosote.

Wash and clear in creosote.

Mount in xylene-balsam.

LIST OF AVAILABLE LITERATURE.

The following bibliographical list includes the titles of practically all of the papers which we have had access to in the determination of species and the preparation of this paper. We have made no attempt to list the economic literature available, as, with a few exceptions, it included nothing of value for systematic work. It will be observed that the number of papers we have had access to is very small compared to the total amount of Coccid literature published.

Brain, C. K.—Contribution to the knowledge of mealy bugs, genus *Pseudococcus*, in the vicinity of Cape Town, South Africa. In Ann. Ent. Soc. Am. Vol. **5** (1913) pp. 177-189, 4 fig. pl. XIV.

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Cockerell, T. D. A.—Tables for the determination of the genera of Coccidae. In Can. Ent. **31** (1899) pp. 273-279, 330-333.

Cockerell, T. D. A. and Parrott, P. J.—Table to separate the genera and subgenera of Coccidae related to *Lecanium*. In Can. Ent. **33** (1901) pp. 57-58.

Comstock, J. H.—Report of the entomologist; pt. ii, report on scale insects. In Rpt. Dept. Agric. for 1880 (1881) pp. 276-350. pl. III-XXII.

Cooley, R. A.—The Coccid genera *Chionaspis* and *Hemichionaspis*. Mass. Hatch Ag. Exp. Sta. Spec. Bull. (1899) pp. 1-57, pl. I-IX.

Douglass, Benjamin W.—Scale Insects of Indiana. In Fourth Rpt. Ind. St. Ent. (1911) pp. 145-226, many illus.

Felt, E. P.—Scale insects of importance, and a list of the species in New York state. N. Y. St. Mus. Bull. **46** (1901) pp. 290-377. 5 fig. 15 pl.

Fernald, Maria E.—A catalogue of the *Coccidae* of the World. Mass. Hatch Ag. Exp. Sta. Bull. **88** (1903) 360 pp.

Frank, A. B. und Kruger, F.—Schildlausbuch, etc., Berlin (1900). Publ. by Paul Parey, 120 pp. 59 fig. 2 pl.

Hempel, A.—As Coccidas Brazilerias. In Rev. Mus. Paulista, vol. **4** (1900) pp. 365-537 figs.

Herrick, Glenn W.—Some scale insects of Mississippi, etc. Miss. Ag. Exp. Sta. Tech. Bull. **2** (1911) 34 pp. 33 pl.

Hunter, S. J.—The Coccidae of Kansas. In Kas. Univ. Quarterly as follows: Pt. I, vol. **8** (1899) pp. 15, 67-77, pl. I-VII, XIII-XVII. Pt. III, vol. **9** (1900) pp. 101-107, pl. XVIII-XXIV. Pt. IV, vol. **10** (1901) pp. 17-145, pl. VIII.

Lindinger, L.—Die Schildlause (Coccidae). Published by Ulmer, Stuttgart, (1912) 388 pp. 37 fig.

Morrison, Harold and Dietz, Harry F.—Some scale insects not heretofore reported from Indiana. In Sixth Rpt. Ind. St. Ent. (1913) pp. 74-78, 7 fig.

Newstead, Robert.—A Monograph of the British Coccidae. **2** vol. Publ. by the Ray Society. Vol. **1** (1900). General and Diaspinae. xii, 220 pp. 20 fig. A-E, XXXIV pl. Vol. **2** (1902) viii, 270 pp. 7 fig. F, XXXV-LXXV pl.

Palmer, Miriam A.—On the dorsal glands as characters of constant specific value in the Coccid genus *Parlatoria*. In Kas. Univ. Sci. Bull. **3** (1905), No. 5, pp. 131-146. pl. 23-28.

Sanders, J. G.—The Coccidae of Ohio I. In Proc. Oh. St. Acad. Sci. vol. **4** pt. **2** (1904). Spec. Paper No. 8. pp. 27-80, pl. I-IX.

Sanders, J. G.—The identity and synonomy of some of our soft scale insects. In Jour. Econ. Ent. vol. **2** (1909). pp. 428-448. pl. 19-20.

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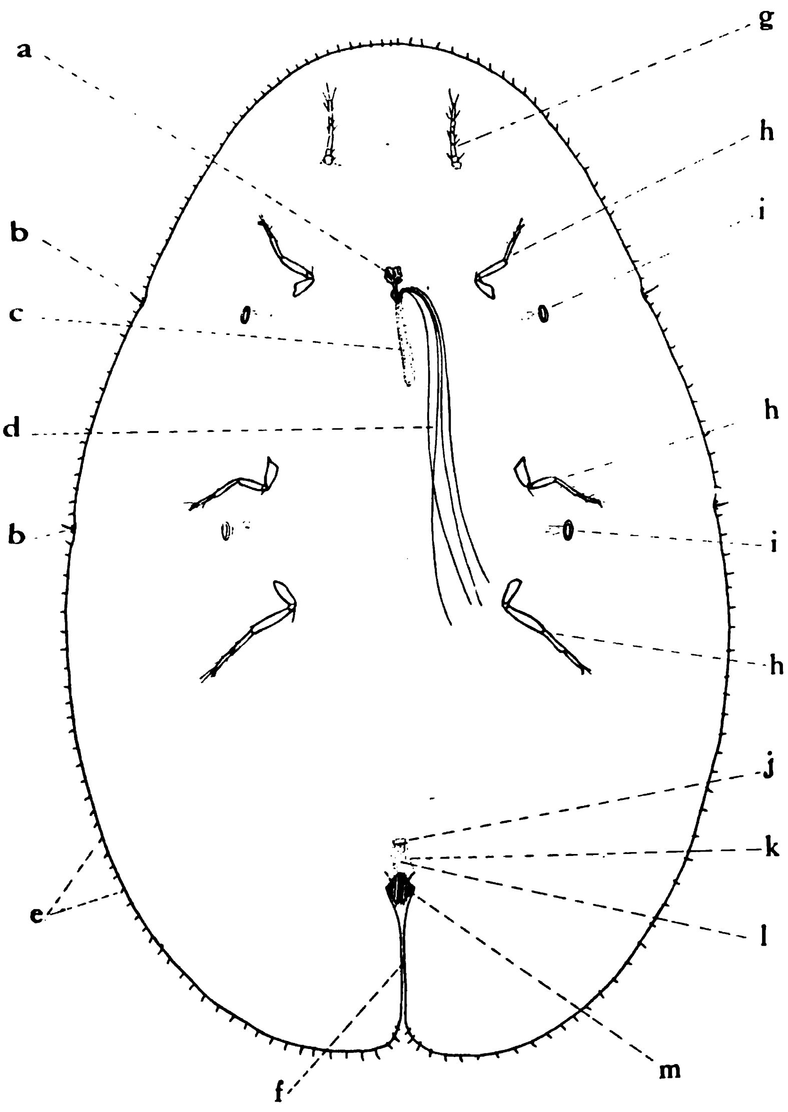
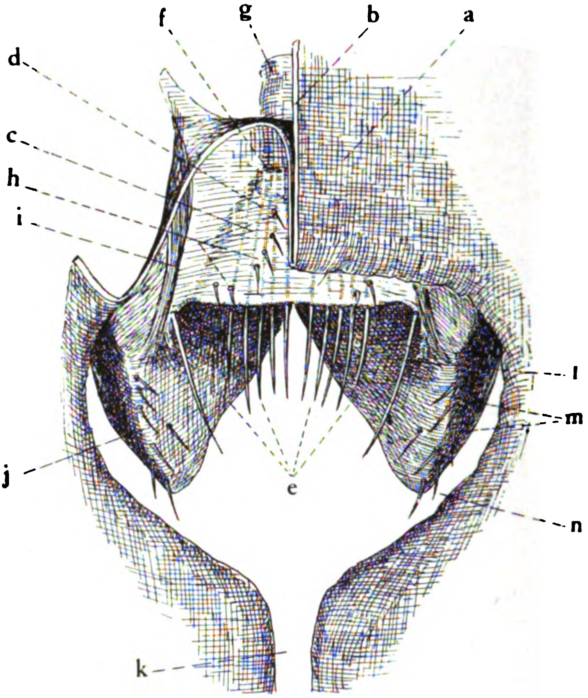
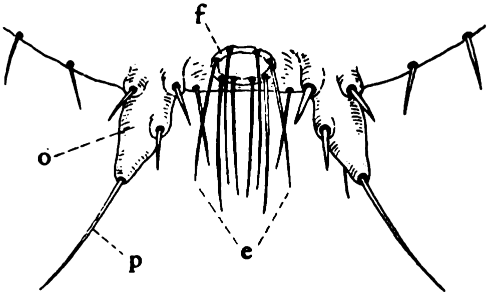


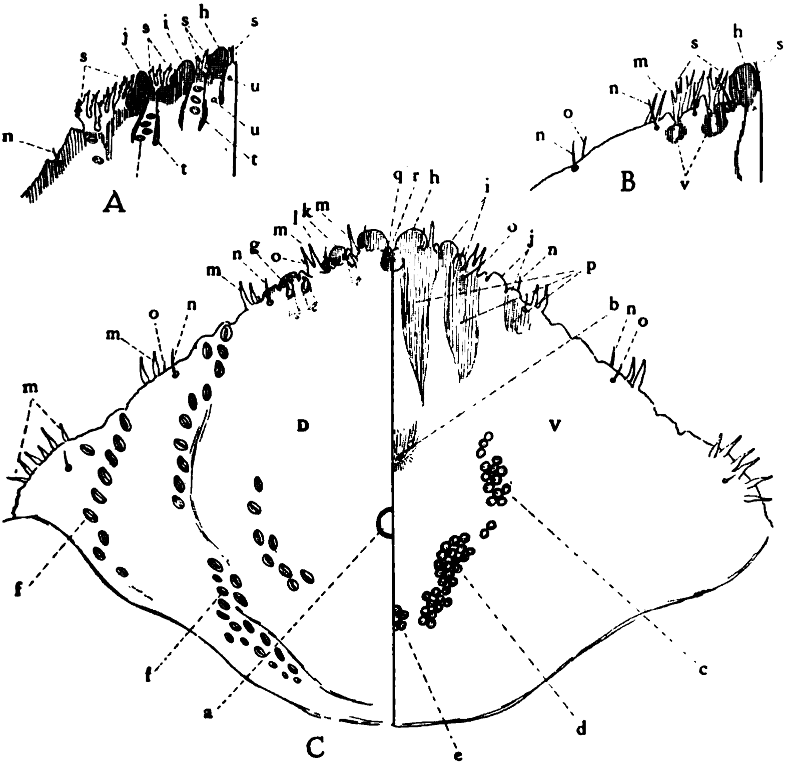
COCCUS HESPERIDUM, outline of body showing (a) beak, (b) spiracular spines in spiracular depression, (c) internal loop of setae (d) of the mouth parts, (e) marginal setae, (f) anal cleft, (g) antenna, (h) leg, (i) spiracle, (j) anal ring, (k) anal tube, (l) anal ring hairs, (m) anal plates.



NEOLECANIUM CORNUPARVUM, apex of anal cleft from below, showing (a) ventral body wall, removed on left side beyond (b) the median cut edge, exposing the pouch beneath the anal tube, through the dorsal wall (c) of which are seen (d) the bases of (e) the anal ring spines, and (f) the anal ring, (g) rectum, (h) hypopygial setae, (i) ventral chitinous processes of (j) the anal plate, (k) anal cleft, (l) fringe seta, (m) subapical setae of anal plate, (n) apical setae of anal plate.



ERIOCOCCUS AZALEAE, caudal apex of body, showing (e) anal ring setae, (f) anal ring, (o) anal lobe, (p) apical hair of anal lobe.



(A) Margin of pygidium of CHRYSOMPHALUS AONIDUM. (B) Margin of pygidium of ASPIDIOTUS RAPAX. (C) Pygidium of adult female of CHIONASPIS SALICIS-NIGRAE, showing (D) dorsal surface, (V) ventral surface, (a) anal opening, (b) genital opening, (c) posterior group of lateral circumgenital gland openings, (d) anterior group of lateral circumgenital gland-openings, (e) median group of circumgenital gland openings, (f) groups of dorsal gland openings, (g) marginal dorsal gland opening, (h) median lobe, (i) second lobe and (j) third lobe, both cleft to form (k) inner lobule and (l) outer lobule, (m) gland spine, (n) dorsal spine, (o) ventral spine, (p) ventral thickening, (q) median chitinous thickening, (r) median notch, (s) marginal plate, (t) elongated chitinous thickening, (u) micropore, (v) incision with thickened edges.

ORDER HEMIPTERA

FAMILY COCCIDAE.

Adult females wingless; body scale-like, gall-like or sac-like, in the latter case clothed with wax; with one-segmented tarsi and a single tarsal claw; without an elongate beak, the beak apparently protruding from between the front legs; males with complete metamorphosis, two wings and a pair of halteres, mouth parts not developed.

There are four or five subfamilies found in Indiana, depending on the classification adopted. We have followed Lindinger (Die Schildlause, Stuttgart, 1912) and recognized the genus *Kermes* as representing a distinct subfamily. The following key to subfamilies is adapted from that given by Lindinger (p. 10).

KEY TO SUBFAMILIES.

A. Anal opening without a hair-bearing ring.
  B. Adult female without a pygidium or a scale covering; globular forms closely resembling certain Cynipid galls, and found only on oaks: (larval forms with a hair-bearing ring surrounding the anus).... .... *Hemicoccinae*
  BB. Abdomen of female terminating in a compound segment, the pygidium; all stages except the just hatched young hidden and protected by a waxy scale readily separated from the insect; adult female very flat, small, antennae and legs wanting....*Diaspinae*
AA. Anal opening with a hair-bearing ring.
  B. Caudal end of body with a more or less distinct cleft; anal opening covered by two more or less triangular anal plates......*Coccinae*
  BB. Caudal end of body without a cleft; anal plates wanting.
    C. Adult female relatively long-legged, and with large white terminal waxy lamellae; males with compound eyes.........*Ortheziinae*
    CC. Adult female relatively short-legged, and without waxy lamellae, although usually more or less covered by waxy or powdery secretion.. *Dactylopiinae*

Subfamily ORTHEZIINAE.

Adult females active; more or less covered with plates or lamellae of waxy secretion, those at the posterior extremity of the body forming an ovisac or marsupium; antennae varying from 4-9 segments; males with compound eyes; male abdomen with a pencil of long filaments.

Genus ORTHEZIA Bosc.

With the characters of the subfamily. This genus includes the single species,

ORTHEZIA INSIGNIS Douglas.

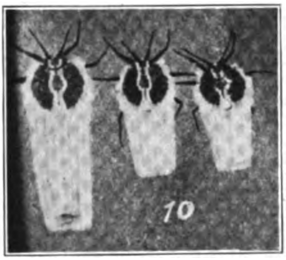
Orthezia insignis Douglas, Jour. Quekett Micr. Club. (1887) p. 169.

Orthezia insignis Dougl. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 34.

Orthezia insignis Dougl. Sanders, Jour. Econ. Ent. **2** (1909) p. 430.

The following description is copied from that given by Newstead (1902, p. 236); as we have no specimens available for description.

ADULT FEMALE: Usually dark bottle-green, very old examples becoming blackish or piceous; legs and antennae fulvous. "Short, broad oval, surrounded (except over the head) by a marginal series of snow-white laterally connected lamellae, these, after the first three on each side, directed backwards and downwards, gradually increasing in length, the posterior ones overhanging the marsupium, but of these the middle three shorter and more distinct, the median one, over the middle channel, shortest and broadest of all, either turned up vertically or horizontal, and having a median sulcation; the dark surface of the body level, nude, the segmentation plainly discernible, but on the middle with two longitudinal, narrow, contiguous yet distinct lines of small, granulose, white, lamellate projections, these lines beginning at the base of each antenna, extending backward for a short distance convergently, but almost immediately after each curving outward and again inward, so as to leave a small, dark, oval space between them; then both parallel, and close together up to the anal extremity; marsupium snow-white, varying in length, margins straight, parallel, the upper side shorter than the lower, longitudinally canaliculate, the median channel wide, two others on each side of it very narrow, and further down on the rounded sides usually slight striate indications of one or two more channels; underside shining, semi-tubular, being transversely very arched, smooth, with the faintest traces of transverse indications of the progressive stages of development, posteriorly curved upward, apex truncate, but the lateral angles produced"

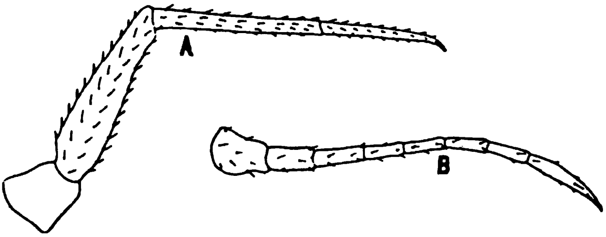


ORTHEZIA INSIGNIS Dougl., natural size. (After Sanders, Jour. Econ. Ent. 2 (1909) pl. 19.)

(Douglas, l. c.). Denuded female, after treatment with potash, ovate, slightly narrowed in front, widely rounded posteriorly; gland-tracts corresponding in position to the external cereous plates, glandiferous spines very slightly curved, bluntly jointed, and suddenly dilated at the base; eyes comparatively small, hemispherical; antennae spinose, of eight segments, apical spine strong, bluntly pointed; mentum biarticulate, basal segment scarcely one-third the length of the apical segment; apex of the latter with several rather long spines; legs rather strongly and closely spinose, especially the tibiae and tarsi; anal orifice with six long hairs; abdominal spiracles tubular, small orifice dilated.

Larva after treatment with potash, ovate, extremities usually equally rounded; gland-tracts forming comparatively narrow transverse bands on the abdominal segments; antennae of six segments, apical segment equalling the length of the third, fourth and fifth together, apical spine very long, acute; anal orifice with six hairs, ring with a double series of punctures; mentum biarticulate.

MALE: Green (l. c.) describes the male "as a very graceful insect—of a slate-gray colour, with very long slender antennae, a single pair of greyish wings, and a tuft of long white silky filaments at the end of the body. The eyes are black and divided into numerous facets."



ORTHEZIA INSIGNIS Dougl.
(A) fore leg; (B) antenna. (After Lounsbury.)

We have only one authentic record for this species, in an Indianapolis greenhouse, March 26, 1915, on Coleus. Mr. Douglass (1911 p. 151) reports this species as having been found in Indiana, but the insect he illustrates as this species is a combination of *Cerataphis lataniae*, a plant louse, and what appear to be the male cocoons of some species of *Pseudococcus*.

Subfamily DACTYLOPIINAE.

(Coccinae of Lindinger.)

Adult females active or stationary, naked or covered with either mealy or waxy secretion; antennae and legs developed in our species, but not long; anal lobes more or less developed; anal ring with setae.

KEY TO GENERA.

A. Anal ring with eight hairs; adult female surrounded or covered by a distinct sac; antennae six segmented.
  B. Adult female surrounded, except dorsally, by a secreted sac; apex of body more protruding; spines of body longer and more slender; anal lobes rather close together, extending caudad of the tips of the anal ring hairs; occurring out-of-doors on elms....... *Gossyparia*
  BB. Adult female completely enclosed in a cottony sac; apex of body broadly rounded with anal lobes projecting caudad a little less than the apices of the anal ring hairs; spines, at least on the anal lobes, shorter and stouter; occurring indoors on azaleas.... *Eriococcus*
AA. Anal ring with six hairs; adult female not enclosed in a true sac; antennae normally seven to nine segmented.
  B. Antennae normally nine segmented; tarsus with a tooth beneath .... *Phenacoccus*
  BB. Antennae normally eight segmented (sometimes seven segmented); tarsus not toothed.............................. *Pseudococcus*

Genus GOSSYPARIA Signoret.

Adult female oval, surrounded except dorsally by a secreted sac; anal lobes well developed, elongate, with a large apical seta and some short ones anterior to the apex; anal lobes extending further caudad than the anal ring hairs; anal ring with eight hairs.

Only a single species of the genus has been found in Indiana.

GOSSYPARIA SPURIA (Modeer).

Coccus spurius Modeer, Act. Goth. **1** (1778) p. 43.
Gossyparia spuria (Mod.), Fernald, Cat. Cocc., Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 69.
Gossyparia spuria (Mod.), Doten, Nev. Ag. Exp. Sta. Bull. **65** (1908) p. 11.

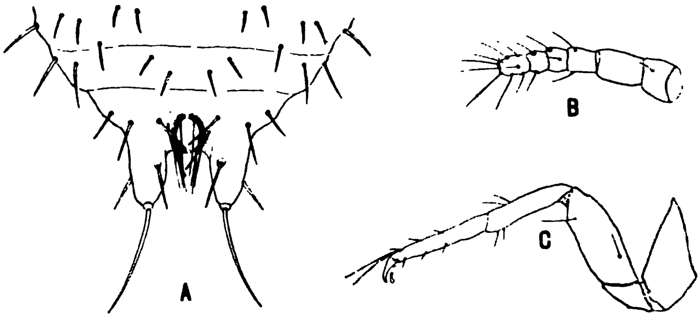
This description has been taken from that given by Doten (1908 p. 11).

ADULT FEMALE: Length from 1.23 mm. to 1.47 mm., average 1.35 mm.; breadth from .63 mm. to .78 mm., average .695 mm.; outline ovate, twice as long as broad, tapering to the two-lobed posterior extremity each lobe of which bears four stout, blunt, dorsal spines and a terminal filament whose length is about equal to one-fifth that of the body; dorsal surface olive green to dark brown; entire dorsum and the lateral margins thickly set with stout, blunt spines; antennae short and stout, their length to that of the body as one is to six; segments of the antennae not so deeply incised as in the male, but the segmentation distinct, third segment the longest, fifth and

sixth shorter than the terminal seventh, which bears a number of short hairs and two longer ones, whose length is to that of the segment as 58 is to 41; femur the longest of the leg segments; the tibia shortest, lengths of femur, tibia and tarsus to each other as 13, 11, and 12; the genito-anal ring surrounded by eight slender, flagelliform hairs not extending to the ends of the anal lobes.

After impregnation the female becomes distended with eggs; so engorged in fact, as to resemble a tiny, leathern sack, roughly globular or ovoid, pointed posteriorly, flattened dorsally; the back smooth and shining, of a deep mahogany-brown color, distinctly segmented. The power of locomotion is lost: but the female is held in place on the bark by a semi-cocoon of wax while the eggs are laid.

This insect has been found once in a nursery near Indianapolis on some fairly large trees of Camperdown or English elm (*Ulmus campestris*), July, 1915.



GOSSYPARIA SPURIA (Mod.).
(A) Anal lobes and anal ring, X110; (B) antenna, X110; (C) fore leg, X110.

Genus ERIOCOCCUS Targioni.

Adult female oval, entirely covered by a white waxy secreted sac; anal lobes well developed, elongate, with an apical spine on each lobe and some before the apex; with the anal-ring hairs extending caudad a little beyond the apex of the anal lobes; anal ring with eight hairs.

There is only one species of the genus found in the state.

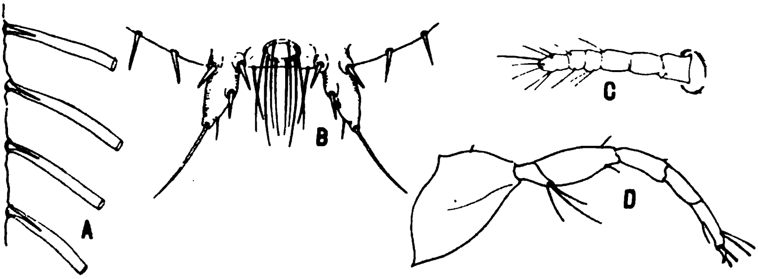
ERIOCOCCUS AZALEAE Comstock.

Eriococcus azaleae Comstock, Rept. U. S. D. A. for 1880 (1881) p. 338.

Eriococcus azaleae Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 72.

The following description is copied from the original description of Comstock (1880 p. 338).

ADULT FEMALE: Length of sac 3 mm., width, 1.5 mm., the female herself being somewhat smaller; the sac dense, pure white, and covered with protruding filaments of white secretion, especially in the younger individuals, nearly oval in form, somewhat pointed at both ends; female removed from the sac dark purple, almost black, shape that of the sac, more rounded anteriorly and pointed posteriorly, almost entirely naked, only a very small amount of the cottony secretion occurring on the ventral surface near anus; whole dorsal surface covered with long stout acuminate yellow spines, and also between these spines with minute pointed tubercles; also with numerous pores; underside of the body comparatively smooth, bearing a very few of shorter spines; antennae 6-segmented, but the bulb when the specimen is pressed under the cover glass often taking on the appearance of an additional segment; segments 1, 2 and 3, are sub-equal in length, segment 1 being perhaps a trifle the shortest; segments 4 and 5 are less than half as long as 1, and are subequal; segment 6 is nearly as long as 3; segments 3, 4 and 5 have each one or more bristles, segment 6 several, none, however, appearing buttoned at tip; tibiae two-thirds as long as the tarsi; tarsal digitules very long and slender, the claw large and strong; lower lip indistinctly 3-segmented, the basal segment widening slightly and the final segment triangular, with four or five hairs upon the disk and two at the summit; anal lobes small, each surmounted at tip by a very long bristle, and each bearing dorsally three of the long tubular spines, two at base and the other on the mesal edge, little more than halfway to tip; there is also a bristle on the ventral surface; anal ring with eight hairs.



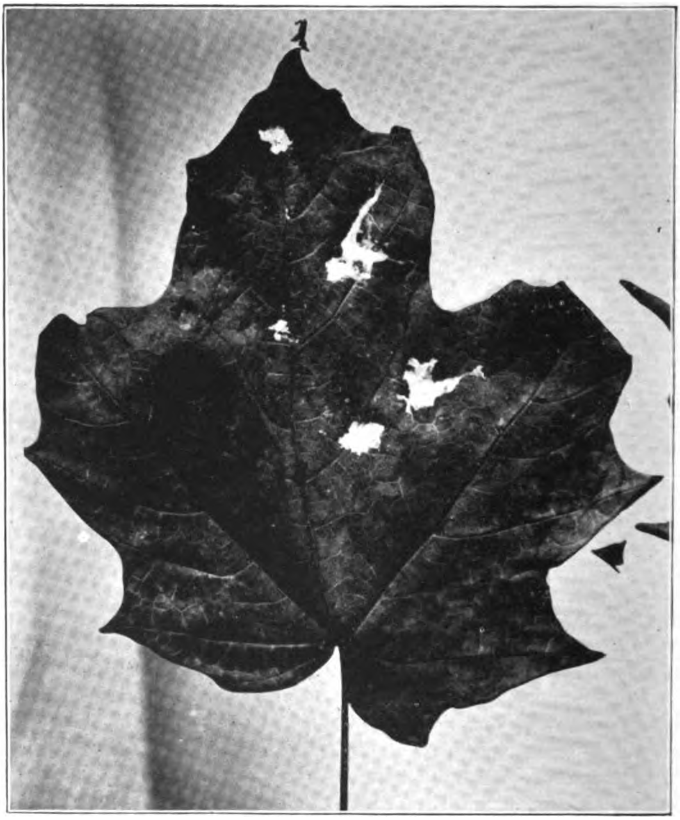
ERIOCOCCUS AZALEAE Comst.
(A) Marginal spines with wax filaments, X200; (B) anal lobes and anal ring, X200; (C) antenna, X110; (D) middle leg, X110.

This scale has been found only once in Indiana in a greenhouse in the southern end of the state, the original collection being made by Mr. P. Ulman, a deputy of this office, Nov. 15, 1915. The host was *Azalea indica.*

Genus PHENACOCCUS Ckll.

Very similar to *Pseudococcus*, but with antennae normally 9-segmented; anal ring with six hairs.

Only a single member of the genus has been found in Indiana.



PHENACOCCUS ACERICOLA King, natural size.

PHENACOCCUS ACERICOLA King.

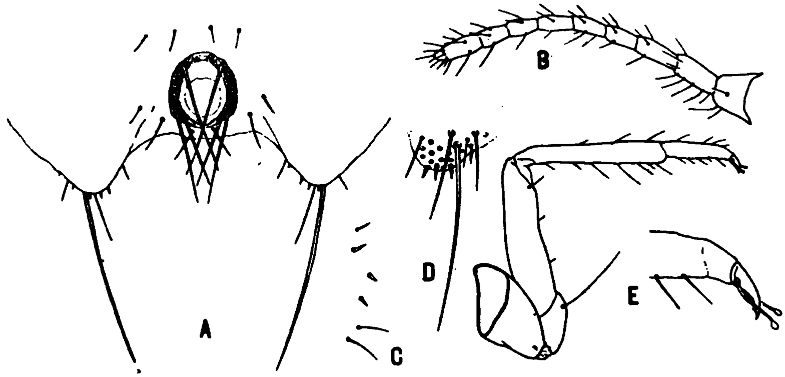
Pseudococcus aceris Smith, E. A., North Am. Ent. (1880) p. 73.

Phenacoccus acericola King, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 89.

Phenacoccus acericola King, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 391.

This description is that given by Comstock (1880 p. 345) for *Pseudococcus aceris* Geoff.

ADULT FEMALE: Color, bright yellow (Smith), reddish yellow (Signoret); length from 4-5 mm.; shape, rounded oval, as large behind as in front; dorsal integument smooth, with the divisions into segments obscure; filled with spinnerets in the form of pores, and also furnished with many delicate hairs, especially numerous upon the median part of each segment and at the extremity of the abdomen; antennae long and delicate, 9-segmented, second and third longest, the others diminishing in size and length except segment 9, which is longer than the preceding segment and acuminate at tip; under lip long, acuminate at tip, which is furnished with many hairs; tibiae are nearly three times as long as the tarsi; the tarsal claws are rather short and toothed on their inner side, sometimes truncate at tip; with only two digitules, those of the claw, the others being only simple hairs; anal genital ring large, punctate, supporting six quite long hairs.



PHENACOCCUS ACERICOLA King.

(A) Anal lobes and anal ring, dorsal, X110; (B) antenna, X110; (C) marginal spines, X110; (D) anal lobe, ventral, X110; (E) middle leg and tarsus, X110 and X200.

EGG: Light yellow in color when first deposited, later becoming yellow brown.

YOUNG LARVA: Color reddish yellow; shape elongate oval, narrow behind; antennae 6-segmented, segment 6 as long as the three preceding segments together; lower lip segmented, surrounded by a series of spines and upon the disk of each segment with series of eight tubercular spinnerets, with which alternate short hairs; in front of the head between the eyes, several longer hairs; anal ring with six hairs; the lateral lobes large, each with one very long hair and several shorter ones; tarsi a third longer than the tibiae.

MALE LARVA: Red and with 7-segmented antennae.

Our records show that this species is rather generally scattered over the state, although so far we have found it only in towns and on the under sides of maple leaves.

Genus PSEUDOCOCCUS Westwood.

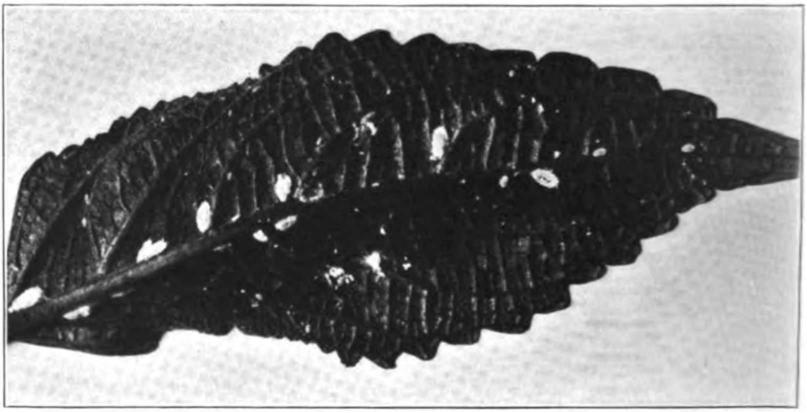
Body oval to elongate oval; antennae normally 8-segmented, sometimes 7-segmented; anal lobes not strongly developed; anal ring with 6 hairs; tarsal claws without a tooth.

We have found three species in the greenhouses of the state, and one species ovipositing on sycamore trees in Indianapolis.

KEY TO SPECIES.

A. Large hair of anal lobes nearly twice as long as the anal ring hairs; dorsum of female covered with irregular waxy secretion; marginal filaments all rather short, finger-like.......................... *citri*

AA. Large hair of anal lobes little, if any, longer than the hairs of the anal ring.



PSEUDOCOCCUS CITRI (Risso), natural size. (After Douglass.)

B. Anal lobes with a nearly circular group of pores surrounding the two stout spines.

C. Tarsus not more than twice as long as its claw; found indoors on a variety of plants.............................. *adonidum*

CC. Tarsus at least three times as long as its claw; found out-of-doors on clover roots and beneath sycamore bark........ *trifolii*

BB. Anal lobes with the pores scattered, not grouped around the stout spines so distinctly; dorsum covered with stout pyramidal waxy elevations, marginal filaments very short and stout.... *pseudonipae*

PSEUDOCOCCUS CITRI (Risso).

Dorthesia citri Risso, Essai, Hist. Nat. des Oranges (1813).

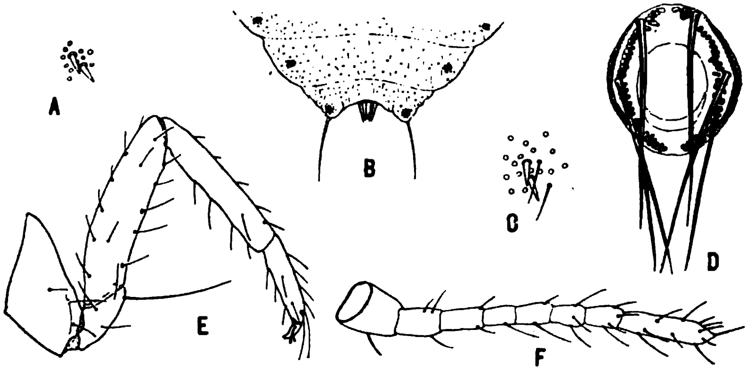
Pseudococcus citri (Risso), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 99.

Pseudococcus citri (Risso) Sanders, Jour. Econ. Ent. 2 (1909) p. 432.

Pseudococcus citri (Risso), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 157.

The following description is from Comstock (1880, p. 342).

ADULT FEMALE: Length, 3.5 mm. to 4 mm., width, 2 mm.; color dull brownish yellow, somewhat darker than with *P. adonidum*, legs and antennae concolorous with body; lateral appendages (seventeen on each side) short and inconspicuous and subequal in length; with powdery secretion very slight upon the surface of the body; in spite of the small size of the filaments, with the spinnerets and the supporting hairs as numerous and as prominent, or nearly so, as in *P. adonidum*, those upon the anal lobes being especially long; antennae 8-segmented, segment 8 the longest and twice as long as the next in length, segment 3, after 3 segments 2 and 7 subequal, then 5 and 6, segment 4 the shortest; tarsi a little more than half the length of the tibiae, claws strong.



PSEUDOCOCCUS CITRI (Risso).

(A) spines and pores on sixth abdominal segment, X200; (B) anal lobes and anal ring, X41; (C) spines and pores on anal lobe, X200; (D) anal ring, X200; (E) middle leg, X110; (F) antenna, X110.

EGG: Length, 0.25 mm.; shape, rather long, ellipsoidal; color, light straw-yellow.

YOUNG LARVA: Rather brighter colored than the egg; antennae 6-segmented in the female, with the same relative proportions, as in *P. adonidum*; tarsi considerably longer than the tibiae; lower lip large, conical, and reaching almost to the posterior coxae.

This species is the common mealy bug of greenhouses and has been found in every greenhouse in the state visited by the writers. It is a serious pest of coleus, acalypha, palms and *Vinca*.

PSEUDOCOCCUS ADONIDUM (Linn.)

Coccus adonidum Linn. Syst. Nat. Ed. **12** (1762) p. 140.

Pseudococcus longispinus Targ. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 104.

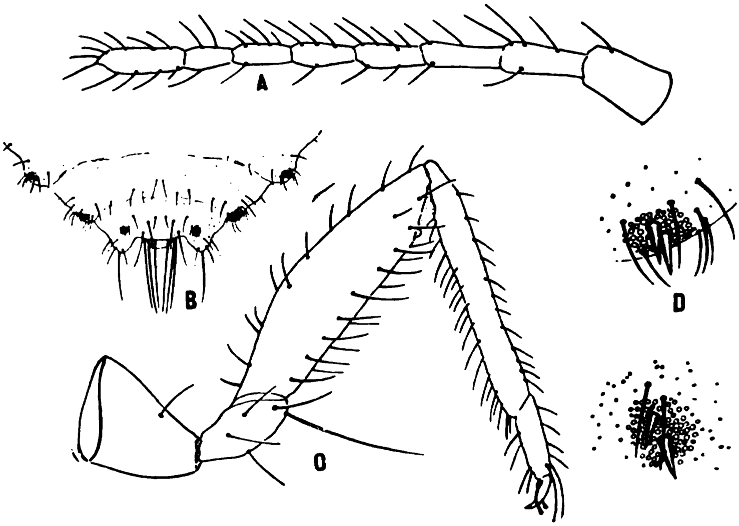
PSEUDOCOCCUS ADONIDUM (Linn.), natural size. (After Douglass.)

Pseudococcus adonidum (Linn.) Sanders, Jour. Econ. Ent. **2** (1909) p. 431.

Pseudococcus longispinus Targ. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 159.

This description is from Comstock (1880 p. 341).

ADULT FEMALE: 2.5 mm. to 3 mm. (0.1 to .12 inch) in length, and 1.5 mm. (.06 inch) in width; white, a little yellowish, with a brown band



PSEUDOCOCCUS ADONIDUM (Linn.).
(A) antenna, X110; (B) caudal end of body showing anal lobes and anal ring, X41; (C) middle leg, X110; (D) spines and pores on sixth abdominal segment, X110; (E) spines and pores on anal lobes, X110.

upon the middle of the back, legs and the antennae a little brownish; powdered with a great quantity of floury matter secreted through pores scattered over the body; in addition to this, each lateral lobe or segment presents a secretion which forms a border of woolly appendages around the body, varying in length, those near the posterior end of the body longer, and four at the abdominal extremity very long, the two internal ones longest, antennae composed of eight segments, the eighth the longest and the third and the second, fourth and fifth the shortest and of equal length, sixth and seventh a little longer than the fourth and fifth; antennae slightly pubescent, especially at the summit of each segment; legs quite long, slightly pubescent, tibia twice as long as tarsus, claw strong and long, with the digitules slender and furnished with a very little knob; upon each segment a great quantity of pores in the form of rounded points and some scattered hairs; each lateral lobe presenting a space with rounded pores, then two conical spines more or less strong; this being the apparatus secreting the cottony matter of which is formed each lateral appendage; the lobes of the extremity of the body with many more pores, and the conical spines much larger, a little lower down with two hairs, one of which is large; around these is condensed the secretion furnished by the pores; anal ring very large, dotted and with six quite long hairs.

LARVA: Varying in size according to its age, more flat, of the same elongated form, and of the same color, but differs in the antennae, which have only six segments. Other individuals, of a uniform shape and more elongated, with 7-segmented antennae, these the males which are to undergo another molt, which very often is indicated by the rolling up of the oval setae and sometimes by the future antennae and legs, which are already indicated within the members of the larva.

This species is far less common than *Ps. citri* but has been taken in greenhouses in widely scattered parts of the state on Boston fern, *Ficus pandurata*, and the stems of *Cycas revoluta*.

PSEUDOCOCCUS TRIFOLII (Forbes).

Coccus trifolii Forbes, 14th Rept. Ins. Ill. (1885) p. 72.

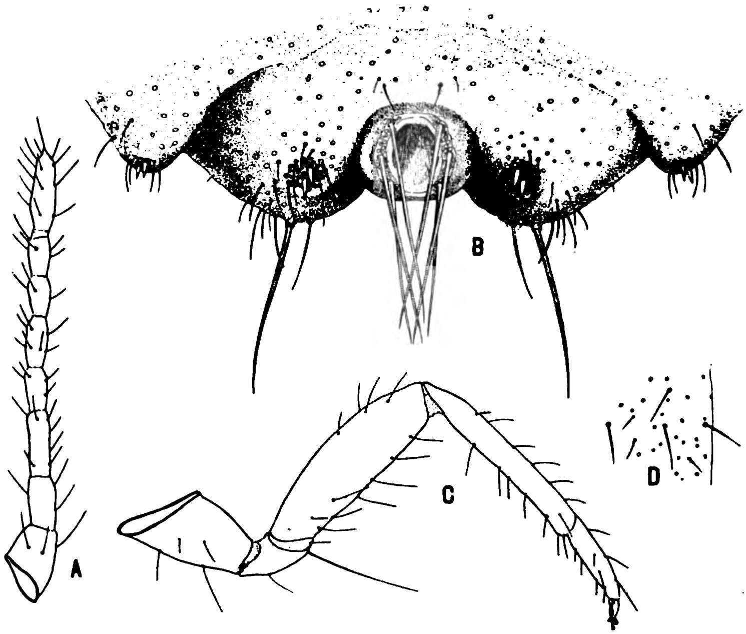
Pseudococcus trifolii (Forbes), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bul. **88** (1903) p. 111.

The following description is taken from Sanders (Coccidae of Ohio (1903) p. 42):

ADULT FEMALE: 2-2. 3 mm. in length, reddish-brown, covered with granular, waxy secretion; with a fringe of seventeen waxy processes around the body, longer at caudal end, sometimes one-third the length of the body; with the legs dirty yellow in color, femur and tibia subequal, tarsus of hind leg more than one-half the length of the tibia; four digitules, the two superior ones long and slender, two inferior stouter and knobbed at tip; antennae 8-jointed, joint one swollen, stout, as broad as long, formula: 8 (321) 5 (467), the fourth joint varies considerably, sometimes smaller, sometimes larger than 5, 6 or 7; anal lobe bears one

long and three short setae, and a mass of small gland-spots with two conical projections; ano-genital ring large, dotted, with six long setae, about same length as anal lobe setae; penultimate segment conspicuously dotted with gland orifices.

We found this species ovipositing beneath the loose bark of sycamores in the northern part of the city of Indianapolis, Sept. 15, 1915. So far we have not found it on its original host, clover.



PSEUDOCOCCUS TRIFOLII (Forbes).

(A) antenna, X110; (B) caudal end of body showing anal lobes and anal ring, X110; (C) middle leg, X110; (D) surface spines and pores near margin of body, X110.

We are indebted to Mr. J. G. Sanders for the identification of this species and it is placed as *trifolii* on the basis of his statement as to its identity.

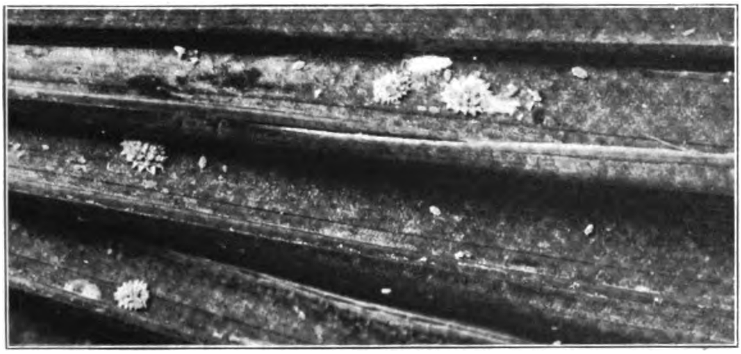
PSEUDOCOCCUS PSEUDONIPAE (Cockerell).

Dactylopius nipae Davis, Mich. Agr. Exp. Sta. Spec. Bull. **2** (1896) p. 28.

Pseudococcus pseudonipae (Cockerell), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 108.

Pseudococcus pseudonipae (Cockerell), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 160.

ADULT FEMALE: Oval to elliptical, heavily coated dorsally with white powdery secretion; margins with a fringe of twenty-four waxy appendages, those on the front half of the body short triangular, those on the caudal half short finger-like and curved backwards; body with a row of more or less distinctly pyramidal waxy elevations just inside the marginal fringe; body beneath nearly naked, or with a little secretion beneath the thorax; body color blood red, legs and antennae short, paler than body; antennae 6-segmented, last a little longer than third, these two the longest; legs round, small; derm pores small, circular, scattered; marginal spines stout, typically with a pair on each side of each segment, at least on the apical abdominal segments; with two blunt swellings between the antennal insertions, each of which bear a number of stout spines similar to the marginal spines; anal lobes of penultimate segment each with only a single long hair and several small ones and with a pair of stout spines; anal ring with 6 hairs, these as long as or longer than the long hair of the penultimate segment.

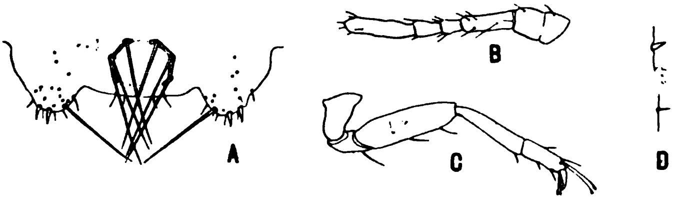


PSEUDOCOCCUS PSEUDONIPAE (Ckll.) slightly enlarged. (After Douglass).

YOUNG FEMALE: Elongate oval, pale yellow.

SECOND STAGE FEMALE: Elongate oval, pale yellow, covered by a faint waxy secretion.

MALE COCOON: Elongate, more or less cylindrical, loosely spun, but so densely matted as to be opaque; usually about twice as long as the insect it contains.



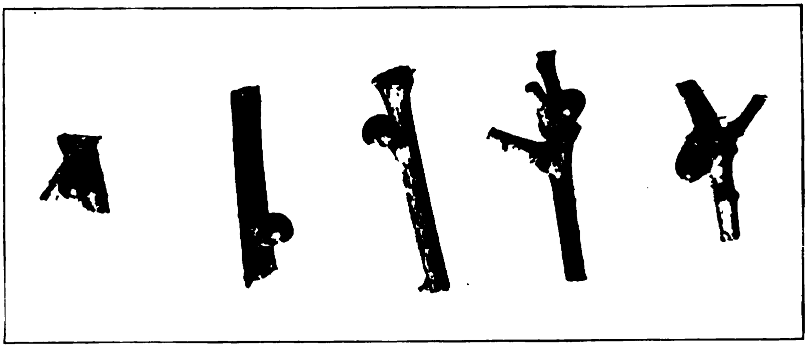
PSEUDOCOCCUS PSEUDONIPAE (Ckll.).
(A) anal ring and anal lobes, X110; (B) antenna, X110; (C) hind leg, X110; (D) marginal spines, X110.

MALE PUPA: Elongate, pale orange yellow, head about one-fourth, wing pads about one-third the length of the body.

We have two authentic records of this species in the state, once at Indianapolis and once at Richmond, in both cases on unidentified palms in greenhouses. Mr. Douglass states that it was found several times in greenhouses during import inspection but gives no definite records.

Subfamily HEMICOCCINAE.

Female, globular, or slightly flattened below, closely resembling a Cynipid gall; anal lobes wanting; anal plates wanting; anal opening without hairs; larvae with anal lobes and anal ring with hairs. Includes only the genus *Kermes*.



KERMES ANDREI King, natural size. (After Douglass).

Genus KERMES Boitard.

With the characters of the subfamily.

Five species have been reported from Indiana.

We have made no attempt to study these insects microscopically, as there seems to be no basis for the differentation of the species on microscopical structural characters. The descriptions are mostly taken from the originals.

KEY TO SPECIES.

A. Scale very convex, approaching conical in form; segmentation well marked by three to five dark lines........................*andrei*
AA. Scale globular or nearly so, or broader than long.
  B. Scale globular or nearly so.
    C. Size small (3-3.5 mm.); shiny, covered with fine pubescence... .... *pubescens*

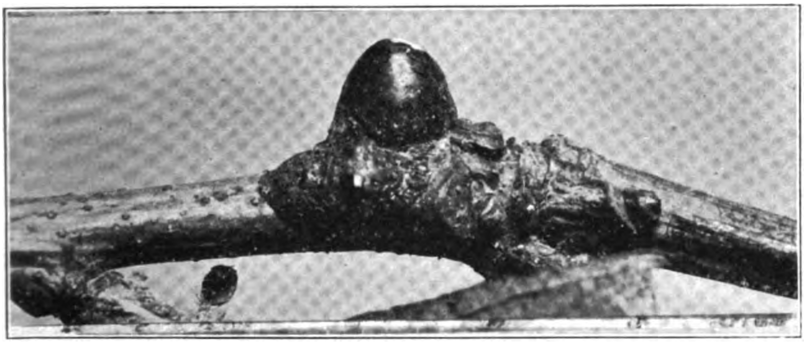
CC. Size larger, not pubescent.
  D. Usually longer than broad, with a pale longitudinal middorsal line running at right angles to the rows of dots.......*kingii*
  DD. Usually globular, dirty gray, black spots irregular, pale bands transverse.................................... *galliformis*
BB. Broader than long, and with a distinct median longitudinal constriction; black spots conspicuous, in transverse rows.....*pettiti*

KERMES ANDREI King.

Kermes andrei King, Psyche, **9** (1900) p. 22.

Kermes andrei King, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 60.

Kermes andrei King, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 151.

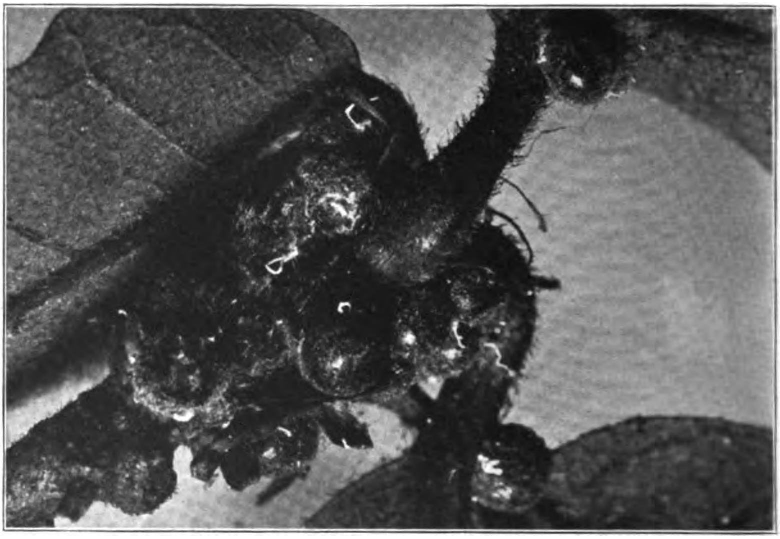


KERMES ANDREI King, enlarged. (After Douglass).

The following is the original description of King:

"Female scale pyriform in shape, very convex, 5 mm. high and 5 mm. in diameter at the base, variable in some individuals which are nearly hemispherical. Surface shiny. Color light brown, with three and sometimes four very dark brown bands, these variable in length and breadth. There are also several suffused dark brown, blotchy spots and round dots, more numerous around the posterior cleft. Segmentation obscure; a median posterior keel-like prominence which is very much wrinkled above near the region of the posterior cleft. When boiled in KOH, the derm is colorless. Rostral loop dark yellow, stout, not very long. No antennae or legs observed. The larvae which were formed in the body of the female are yellow, elongate-oval, 360 mu. long, 160 mu. broad. Antennae 6-segmented, 3 and 6 about equal and longest; 1 next, then 2 and 5 which are equal. 4 is the shortest. Formula: (3, 6) 1, (2, 5), 4. Antennal segments— (1) 20, (2) 16, (3) 24, (4) 12, (5) 16, (6) 24. Segments 4, 5 and 6 have a few short hairs. Legs short and stout. Femur with trochanter, 76 mu. long. Tibia with tarsus, 68 mu. long. Tarsal digitules, long fine hairs with knobs; digitules of claw reaching a little beyond the claw. Caudal tubercles quite large, each bearing one long stout bristle (120 mu. long) and three long stout spines (28 mu. long). The marginal spines pointing backwards and about the same length and breadth as those on the caudal tubercles. Rostral loop reaching beyond the last pair of legs. Eggs oval, 320 mu. long 240 mu. broad."

This insect has been found near Noblesville, near Indianapolis, and at Vincennes, and will probably be found in other localities.



KERMES PUBESCENS Bogue, much enlarged. (After Douglass).

KERMES PUBSECENS Bogue.

Kermes pubescens Bogue, Can. Ent. **30** (1898) p. 172.
Kermes pubescens Bogue, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 64.
Kermes pubescens Bogue, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 154.

The following is the original description of Bogue:

"Female scale spheroidal, 3.5 mm. in diameter, 3 high, pointed and grooved beneath; covered all over with short straggling pubescence. Color rather light brown, with more or less obscure and suffused dark brown bands, marking the obsolete segments. Surface shining, with minute concolorous specks but no dark spots or pits."

"The larvae of *K. pubescens* differ from the larvae of any other known species by having six rows of short conical spines and short caudal setae. The body is narrower and longer and more attenuated posteriorly. In the larvae of *K. pubescens* and *K. ceriferus*, the sixth antennal segment is longer than the third." (Sanders, Cocc. Ohio. [1903] p. 37).

This insect seems to be the most common *Kermes* in the state, although all of our records are from the vicinity of Indianapolis. The most common host is burr oak (*Quercus macrocarpa*).

KERMES KINGII Cockerell.

Kermes kingii Cockerell, Ann. & Mag. Nat. Hist. Ser. 7 (1898) p. 330.
Kermes kingii Ckll., Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 63.
Kermes kingii Ckll. Morrison & Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 74.

This description is copied from that given by Sanders, (Coccidae of Ohio [1903] p. 36).

"Female scale longer than broad; about 5 mm. in length, 4-4.5 mm. broad, and 3.5 mm. high. Almost invariably attaching itself in or at the forks of twigs, or at base of leaf petioles. Color bright ochreous or sometimes lighter, marbled with a more reddish tint, sometimes almost terracotta, with pale longitudinal dorsal band crossed at segments by short more or less broken dark lines, otherwise the segmentation is very indistinct. Small dark spots not prominent and scattered rather promiscuously; numerous minute specks discernable with hand-lens."

This has been found in two places in Indiana, in both cases in towns. One record was Covington, May 31, 1913, on shingle oak (*Quercus imbricaria*), and again at Indianapolis, Feb. 22, 1914, on *Quercus sp.* It was scarce in both places.

KERMES GALLIFORMIS Riley.

Kermes galliformis Riley, Am. Nat. **15** (1881) p. 482.
Kermes galliformis Riley, Fernald Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 61.
Kermes galliformis Riley, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 151.

This description is taken from King (Psyche **9** [1900] p. 79).

"A large dark dirty-gray form, which turns to a nearly white color when exposed a season on the twigs. Female scale 6 mm. long, 7 mm. broad, 6 mm. high, with black spots, and viewed with a hand-lens, the scale is seen to be covered with minute black specks. Newly hatched larvae dirty-gray."

Kermes galliformis was found once in Brown county and again in Marion county near Indianapolis, during the summer of 1911, but has not been found since. The host was white oak (*Quercus alba*).

KERMES PETTITI Ehrhorn.

Kermes pettiti Ehrhorn, Can. Ent. **31** (1899) p. 7.
Kermes pettiti Ehrhorn, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 64.
Kermes pettiti Ehrhorn, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 151.

This description is taken from the original by Ehrhorn.

"Female scale about 4 mm. broad, 3 mm. long and 5 mm. high, dark purplish brown; some individuals of a lighter color and marbled with brown. A distinct longitudinal groove on the meson indicated by a dark line. Surface without minute black specks. Segmentation not very distinct, indicated by rows of black spots plainly seen through a pocket-lens. Ventral surface where it touches the bark, flattened and more or less covered with a yellow secretion. Beak very prominent. When removed from twig, scale leaves a whitish powder. When boiled in KOH, derm colorless except numerous brown spots with dark centers scattered over the dorsum. Antennae very obscurely 6-jointed, joint three apparently longest. Legs very small and stout. Tibia as broad as long, with a stout spine. Femur and tibia almost equal. Tarsus nearly twice as long as tibia. Claw straight."

This species was found during the preparation of Mr. Douglass' list, but no record of its distribution was made at that time, and we have not found it since.

Subfamily COCCINÆ.

Usually rather heavily chitinized, flat to convex, circular to oval, the caudal apex of the body distinctly cleft, with a pair of anal plates at the cephalic apex of this cleft, anal opening below and between these plates, with a ring bearing 8-10 hairs.

We have found representatives of seven genera in the state. Two of these, as will be discussed later, we believe should be united, as we are unable to find any distinguishing characters which we consider generic.

KEY TO GENERA.

A. Body of adult female marked off into large plate-like areas by lighter lines; very flat, elongate oval, usually irregular in shape; anal cleft very long; middle spiracular spine more than twice as long as the outer ones; occurring on palms in greenhouses . . . . *Eucalymnatus*

AA. Body of female not marked off into plate-like areas; at least slightly convex; anal cleft shorter.

- B. Antennae and legs very much reduced, "rudimentary"; anal ring with ten hairs; spiracular spines approximately equal in length, all short and stout.
  - C. Dorsal surface, at least around the anal plates, with setae of two sizes, the smaller very minute; apparently with only large circular gland pores; adult female hemispherical, surface often irregular; occurring in clusters on branches of yellow or tulip poplar .... *Toumeyella*
  - CC. Dorsal surface, at least near the anal plates, with setae of only one size; derm pores apparently of two sizes, large circular ones, and much smaller, more oval and apparently double ones; adult female more oval and less convex than in the preceding; occurring on magnolia.......................... *Neolecanium*
- BB. Antennae and legs fairly well developed, not "rudimentary"; anal ring with eight hairs; middle spiracular spine distinctly longer than the outer two, all more slender than in the preceding genera.
  - C. Adult female secreting a white cottony ovisac in which the eggs are deposited; middle spiracular spine more than twice as long as the outer two.................................. *Pulvinaria*
  - CC. Adult female not secreting an ovisac, the eggs deposited beneath the body of the female.
    - D. Size very large, 10-13 mm.; found out-of-doors on trees.... ....*Lecanium caryae*
    - DD. Size smaller, not over 6 mm.
      - E. Dorsum of body with a row of about thirty tiny, easily detached tubercles running cephalad from the anal plates; middle spiracular spine at least twice as long as the outer ones.........................*Lecanium nigrofasciatum*
      - EE. Dorsum of abdomen without such tubercles.
        - F. Middle spiracular spine distinctly less than twice as long as the others; found out-of-doors...............*Lecanium*
        - FF. Middle spiracular spine at least twice as long as the outer ones; greenhouse species.
          - G. Body only slightly convex, oval or elongate oval; derm with small scattered pores.................*Coccus*
          - GG. Body convex, usually nearly hemispherical; derm closely crowded with large circular or oval pores..*Saissetia*

Genus PULVINARIA Targioni.

Adult female not very heavily chitinized; secreting a cottony sac for the reception of the eggs; body only slightly convex; spiracular spines rather slender, the median more than twice as long as the outer two; anal ring with 8 hairs.

Three species have been found in Indiana.

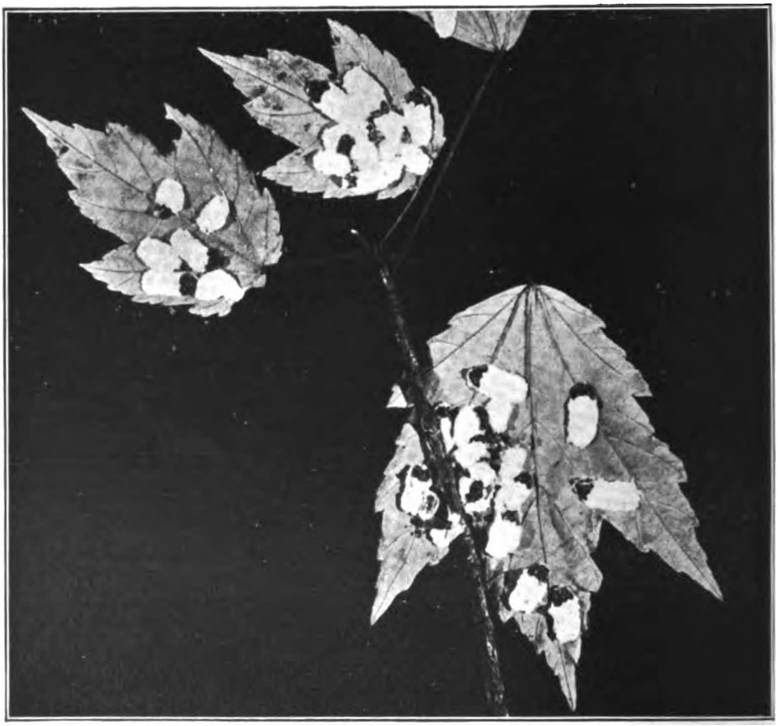
KEY TO SPECIES.

A. Adult female with at least the center of the dorsum of the body filled with very large, circular to oval derm pores which are closely set; ovisac elongate, convex; dorsum of female with white waxy tufts; adult female on leaves of maple........................*acericola*

AA. Adult female with scattered or irregularly grouped derm pores which are smaller than in the preceding species.

  B. Adult female secreting a stout convex ovisac which is not much longer than the body of the fully developed female; occurring on twigs of maple, etc..*vitis*

  BB. Adult female secreting an elongate parallel-sided ovisac, much longer than the body of the female; occurring in greenhouses on *Acalypha* ....*floccifera*



PULVINARIA ACERICOLA (W. & R.), natural size.

PULVINARIA ACERICOLA (Walsh & Riley).

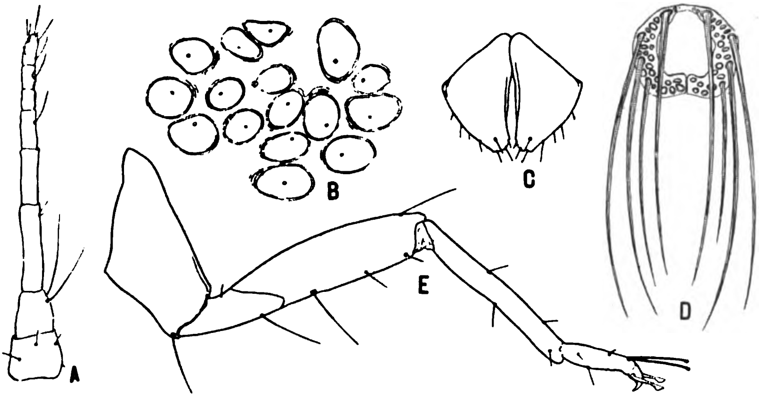
Lecanium acericola Walsh & Riley, Am. Ent. **1** (1868) p. 14.

Pulvinaria acericola (W. & R.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 128.

Pulvinaria acericola (W. & R.), Sanders, Jour. Econ. Ent. **2** (1909) p. 435.

Pulvinaria acericola (W. & R.), Douglass, Fourth Rpt. Ind. Ent. (1911) p. 161.

ADULT FEMALE: Adult impregnated female about 5 mm. long by 3.5 mm. broad, and 2 mm. high; dark purple, with brownish yellow mid-dorsal stripe, and 3 rows of small waxy spots on each side; wax of the ovisac forming a circle beneath the female, complete ovisac about 10 mm. long, largest behind, and somewhat ribbed longitudinally; not very heavily chitinized; antennae 8-segmented, large but rather slender, third segment the longest; legs large and stout, derm pores of two sorts, those near the center of body very large closely set pores, circular or oval in shape, resembling the pores of *Saissetia oleae*; those along the margins of the body minute and scattered; marginal spines long, rather slender; spiracular spines large, fairly stout, the median about twice as long as the other two; some small surface setae present; anal plates about twice as long as wide, outer angle rounded, caudo-lateral margin slightly longer than cephalo-lateral, with two or three fringe setae on each side, with two subapical and four apical setae; anal ring with eight hairs.



PULVINARIA ACERICOLA (W. & R.).
(A) antenna, X110; (B) median dorsal derm pores, X110; (C) anal plates, X110; (D) anal ring, X200; (E) middle leg, X110.

We have found this insect only once, at Ferdinand in southern Indiana. Douglass states that it has been found in several places in the state, but gives no definite records. The only host we know for Indiana is red maple (*Acer rubrum*).

PULVINARIA VITIS (Linn.)

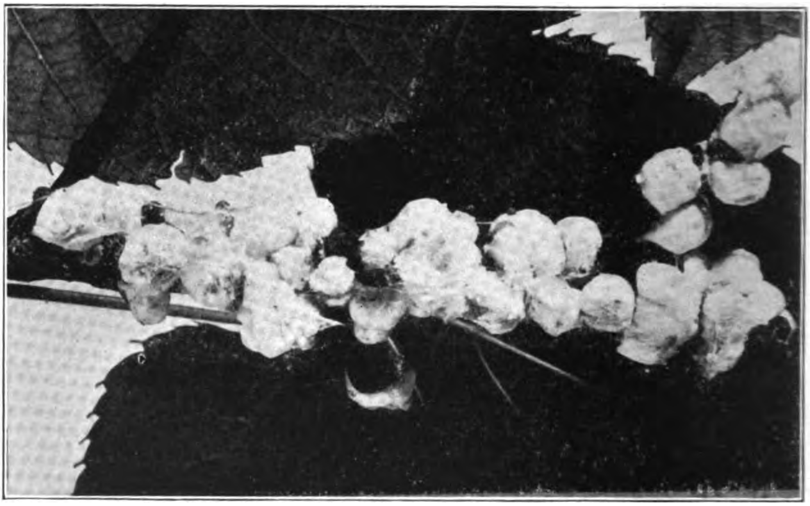
Coccus vitis Linnaeus, Syst. Nat. Ed. **X** (1758) p. 456.

Pulvinaria vitis (Linn.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 140, and 134 (*innumerabilis*).

Pulvinaria vitis (Linn.) Sanders, Jour. Econ. Ent. **2** (1909) p. 433.

Pulvinaria vitis (Linn.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 161, and 160 (*innumerabilis*).

ADULT FEMALE: Elliptical, approaching cordate, convex, about 4-6 mm. long and 3-4.5 mm. broad; with a more or less distinct median ridge, and the surface transversely wrinkled and apparently punctate; color varying from pale to dark brown; closely attached to the bark before the formation of the ovisac, but strongly tilted, sometimes as much as 45 degrees, at the completion of the ovisac which is stout, oval and white; not heavily chitinized; antennae normally 8-segmented, third segment usually longest; legs small, normal; derm pores small, scattered, occasionally occuring in pairs or clusters; marginal spines long, fairly stout, spiracular spines fairly stout, the middle one more than twice as long as the other two; with four fringe setae arranged in a pair on each side, with two subapical and four apical setae; anal ring with eight hairs.

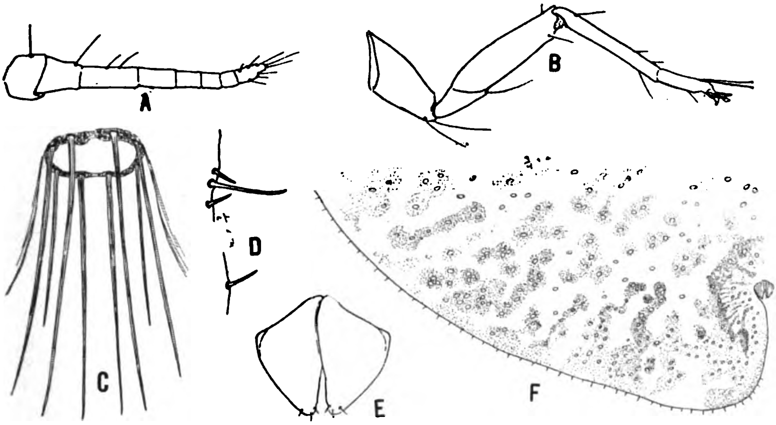


PULVINARIA VITIS (Linn.), natural size.

P. vitis is a widespread and very common insect in Indiana, and may be found in practically every town in the state. It has been definitely recorded from hard and soft maples (*Acer saccharum* and *saccharinum*), sycamore (*Platanus occidentalis*), linden (*Tilia americana*), grape, elms (*Ulmus sp.*) and box elder (*Acer negundo*). It is often a serious pest particularly on maple shade trees.

PULVINARIA FLOCCIFERA (Westwood).

Coccus floccifera Westwood, Gard. Chron. (1870) p. 308.
Pulvinaria floccifera (Westw.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 132.
Pulvinaria floccifera (Westw.), Morrison & Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 74.



PULVINARIA VITIS (Linn.).
(A) antenna, X110; (B) hind leg, X110; (C) anal ring, X110; (D) marginal and spiracular spines, X110; (E) anal plates, X110; (F) derm pore arrangement, X17.

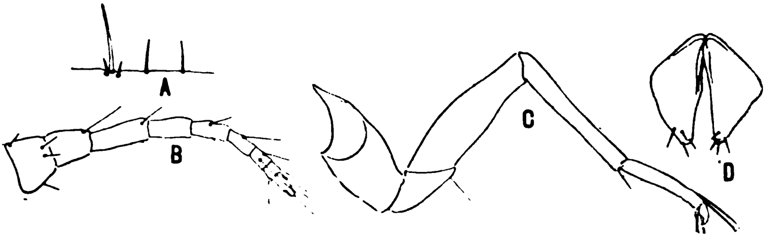
The following description is copied from that given by Newstead (1902 p. 71), as we at present have no specimens which are satisfactory for study.

ADULT FEMALE: In life distinctly cordate, but becoming much wrinkled after gestation. Color pale yellow, lower half of body mottled with reddish brown, or brightly ochreous; after parturition the color usually changes to dusky ochreous. After treatment with potash the form is more ovate. Antennae usually of eight segments but some examples occur with only seven. In the eight segmented antennae, the first four the longest, and the sixth and seventh segments the shortest; with one long and one short hair on the second and fifth, one shorter one on the sixth and seventh and several on the apical segment. Legs about one-third longer than the antennae, very strong, with two or three short hairs on the coxa, a very long one on the trochanter, and several short ones on the femur, tibia, and tarsus; digitules to claw very long, broad, and dilated at apex; those of the tarsus scarcely longer, and faintly clubbed. Marginal hairs simple and very slender; spiracular spines arranged in a triangle; the two inner ones, short, broad, and obtuse are about half the length of the outer one, which is curved towards the tip and usually pointed. Dermis above with numerous irregular ovate pores or glands; spinnerets on ventral dermis, long and tubular, resembling those in the Diaspinae. Dorsum immediately above anal plates, with three pairs of long, equidistant hairs, and a group of shorter ones in the centre of the cephalic area. Rostral loop not extending beyond insertion of intermediate legs.

PULVINARIA FLOCCIFERA (Westw.). Natural size on Acalypha.

Long, 2-3 mm.; wide, 1.50-2 mm.

Ovisac of adult female very elongate, from five to eight times the length



PULVINARIA FLOCCIFERA (Westw.).
(A) marginal and spiracular spines, X110; (B) antenna, X110; (C) middle leg, X110; (D) anal plates, X110.

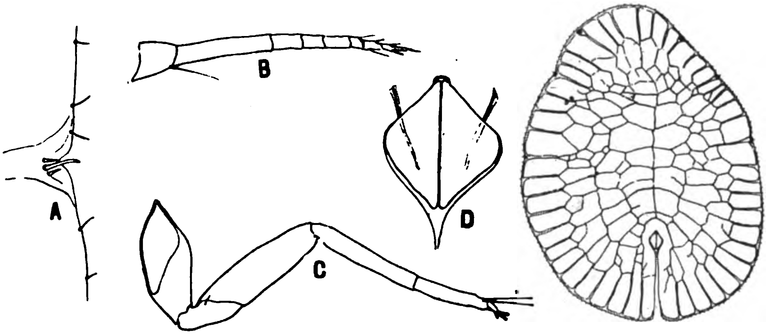
of the adult insect, straight or curved; sometimes examples cross each other, and when overcrowded form irregular masses of white flocculent matter on the branches and leaves of the food-plant.

Long, 5-11 mm.; wide, 2 mm.

Immature female pale yellow, eyes piceous, anal plates, reddish brown, alimentary canal dusky brown, showing through the integument in the form of a long, irregular, narrow loop; underside paler.

Eggs pink.

We located this species in two Indianapolis greenhouses Sept. 5, 1913, but have been unable to find it since then. The host was *Acalypha.*



EUCALYMNATUS TESSELLATUS (Sign.).
(A) marginal and spiracular spines, X110; (B) antenna, X200; (C) middle leg, X200; (D) anal plates, X110; (E) surface of body showing plate-like areas.

Genus EUCALYMNATUS Cockerell.

Adult female very flat, elongate oval, often irregular in shape, anal cleft very long; surface of body broken up into plates.

Only a single greenhouse inhabiting species occurs in the state.

EUCALYMNATUS TESSELLATUS (Signoret).

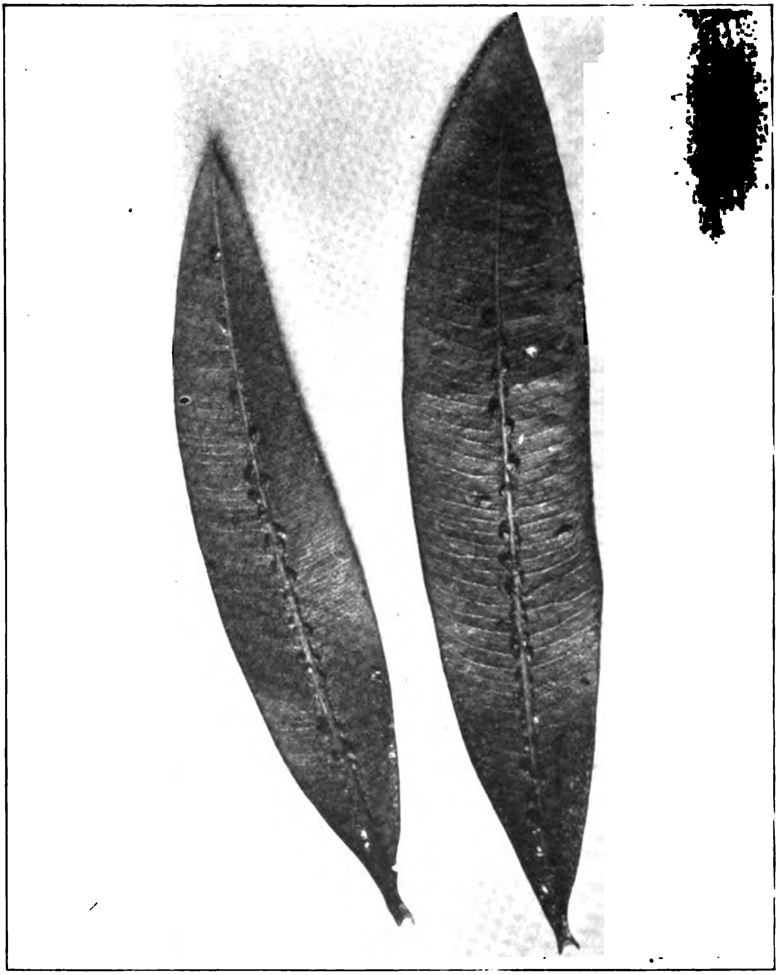
Lecanium tessellatum Signoret, Ann. Soc. Ent. Fr. Ser. 5, vol. **3** (1873) p. 401.

Eucalymnatus tessellatus (Sign.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 166.

Eucalymnatus tessellatus (Sign.), Sanders, Jour. Econ. Ent. **2** (1909) p. 435.

The following description is that given by Thro (1903 p. 212):

ADULT FEMALE: Shape oval, broader posteriorly, and very flat; dorsal cuticle dark brown and divided into large plates by clear lines with small clear dots around margin of plates; round clear spots occur in the marginal plates and irregular clear spots in the other plates with one irregular clear space in each of the posterior submarginal plates; length 3.5 mm. to 4 mm.; width, 2.5 mm. to 3 mm.; antennae long and slender, with eight segments, the suture between the fourth and fifth segments indistinct, the fourth the longest; anal plate over twice as long as broad, with the caudo-lateral margin slightly longer than the cephalo-lateral, the apex very sharp and the lateral extremity angulate; anterior end of the crease between the plates terminating in a V-shaped mark, with three subapical and three apical setae; with four very long fringe setae with the inner one of each group shorter; median spiracular seta two and one-half times as long as the first and



COCCUS HESPERIDUM Linn.. natural size. (After Douglas s.)

slightly hooked at the apex; marginal setae slender and either acuminate or bifurcate.

We have found only a single specimen of this scale in Indiana, in a greenhouse at Richmond, Nov. 4, 1915, on *Washingtonia sp.*

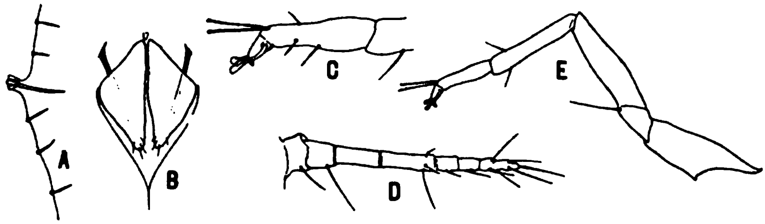
Genus COCCUS Linn.

Adult female; body slightly convex, oval to elongate oval; middle spiracular seta more than twice as long as the other two; derm pores small, scattered; anal ring with 8 hairs.

Two species have been found in the greenhouses of the state.

KEY TO SPECIES.

A. Antennae normally seven segmented; body oval.......*hesperidum*
AA. Antennae normally eight segmented; body more elongate..*elongatus*



COCCUS HESPERIDUM Linn.
(A) marginal and spiracular spines, X110; (B) anal plates, X110; (C) tarsus and claw, X200; (D) antenna, X110; (E) fore leg, X110.

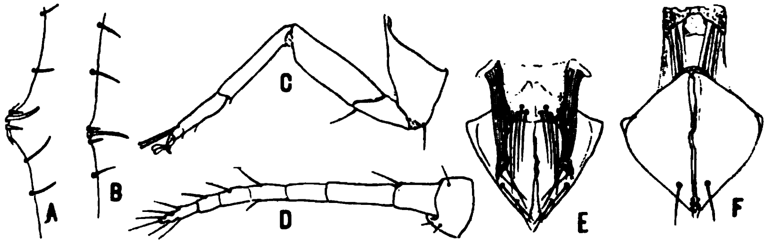
COCCUS HESPERIDUM Linn.

Coccus hesperidum Linnaeus, Syst. Nat. Ed. **X** (1758) p. 455.
Coccus hesperidum Linn., Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 168.
Coccus hesperidum Linn., Sanders, Jour. Econ. Ent. **2** (1909) p. 436.
Coccus hesperidum Linn., Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 166.

This description is taken from that given by Thro (1903 p. 206).

ADULT FEMALE: Shape oval, broader posteriorly, slightly convex, dorsal cuticle yellowish brown, darker towards the center, with occasional clear areas each containing a very small dot, and with a few small setae on the dorsal surface; length, 3-4 mm.; width, 2 mm.; antennae long and slender and seven segmented, with the fourth the longest; anal plate slightly more than twice as long as broad, with its caudo-lateral margin one-fifth longer than its cephalo-lateral, both the lateral extremity and the apex rounded; cephalic end of crease between the dorsal portions of the plates terminating in a V-shaped mark; with two subapical and four apical setae on each plate; apical setae situated as follows: two adjacent and directly on the apex; one on the outer lateral margin and projecting at a right angle; and one on the inner lateral margin near the apex; with four fringe setae arranged in groups of two, with the lateral seta of each group one-fourth longer than the mesal seta; median spiracular seta almost three times as long as the first, first and third short and conical; marginal setae short and hair-like and occasionally bifurcate at apex; viviparous, only a small portion of the ventral body-wall becoming concave when the young are born.

This is a very common greenhouse scale occurring on a wide variety of hosts and in practically every greenhouse in the state. The principal hosts we have records of are "bay tree" (*Laurus nobilis*), rubber plants (*Ficus elastica* and *pandurata*), palms (*Kentia*, etc.), oleander, citrus trees, English ivy, Cape jasmine.



COCCUS ELONGATUS (Sign.).
(A) and (B) marginal and spiracular spines, X110; (C) fore leg, X110; (D) antenna, X110; (E) anal plates ventral, X110; (F) anal plates dorsal, X110.

COCCUS ELONGATUS (Sign.).

Lecanium elongatum Signoret, Ann. Soc. Ent. Fr. Ser. 5 vol. 3 (1873) p. 404.

Coccus longulum (Douglas), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. 88 (1903) p. 171.

Coccus elongatus (Sign.), Sanders, Jour. Econ. Ent. 2 (1909) p. 438.

The following description is taken from Thro (1903 p. 214):

ADULT FEMALE: Shape narrow, long, with rounded ends, dorsum slightly convex, dorsal cuticle pale yellow and sparsely alveolate; length, 4-5 mm., width, 2-2.5 mm.; antennae with eight segments typically, with the third segment the longest and without setae, with one long and two short setae on the fifth segment; anal plate almost as broad as long, with its cephalo-lateral margin six-sevenths as long as its caudo-lateral, the apex sharp; with four subapical, one discal and three apical setae on each plate, one of the latter being on the inner lateral margin; with eight fringe setae, in groups of four, with one in each group one-half as long as the longest; median spiracular seta slightly over three times as long as the first, the first and third long and conical; most of the marginal setae acuminate but an occasional one serrated át the end, but not so distinctly as in *hemisphaericum*.

C. elongatus has been found in two greenhouses in Indiana, once at Indianapolis on Nov. 17th, on *Ficus pandurata* and again on the same host at Evansville the latter part of December, this last collection being made by Mr. P. Ulman, a deputy of this office.

Genus NEOLECANIUM Parrott.

Adult female, body more elongate oval than in *Toumeyella;* legs and antennae reduced, "rudimentary"; spiracular spines very short and stout, approximately equal in length; anal ring with 10 hairs; hypopigial setae present.

NEOLECANIUM CORNUPARVUM (Thro). natural size. (After Sanders. Jour. Econ. Ent. 2 (1909) pl. 19.)

Only one species has been found in the state.

NEOLECANIUM CORNUPARVUM (Thro).

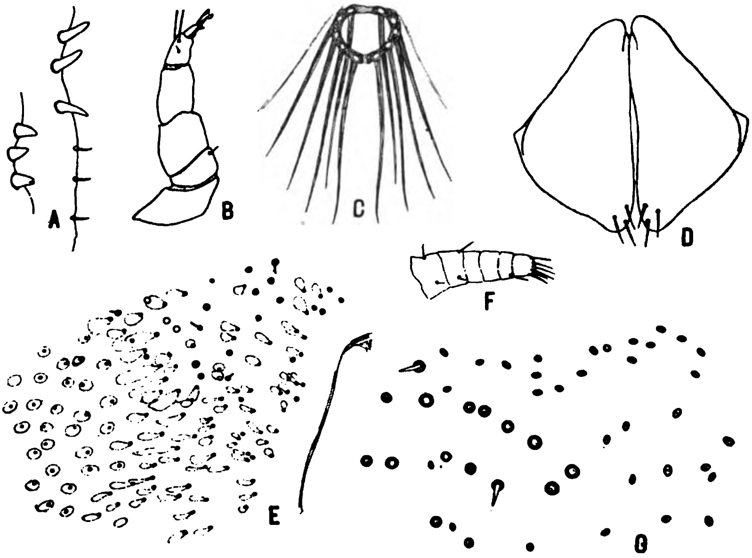
Lecanium cornuparvum Thro, N. Y. Cornell Exp. Sta. Bull. **209** (1903) p. 216.

Neolecanium cornuparvum (Thro), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 176.

Neolecanium cornuparvum (Thro), Sanders, Jour. Econ. Ent. **2** (1909) p. 448.

The following is the original description of Thro:

ADULT FEMALE: Shape elliptical and quite convex; dorsal cuticle shiny brown with a tinge of grey, densely alveolate, with large glands; length, 8-10 mm. width, 5-8 mm.; spiracular grooves leaving a white dust when the insect is removed from the bark; antennae short and stout with six indistinct segments, of the vestigial type; anal plate is two hundred and forty-eight microns long (the anal plate of *hesperidum* is two hundred microns long) and is two-thirds as broad as long with the cephalo-lateral margin longer than the caudo-lateral, and both the lateral extremity and the apex rounded; with five subapical and four apical setae, two fringe setae one on each ventral thickening and at least sixteen hypopygial setae; three short, stout spiracular setae, subequal in length and about one-half as broad as long, with the median seta often notched at the apex; marginal setae short and conical; legs short and stubby with a small claw; viviparous, with the young scales black, the dried young with a median carina and many transverse carinae.



NEOLECANIUM CORNUPARVUM (Thro.).
(A) marginal and spiracular spines, X110; (B) hind leg, X110; (C) anal ring, X110; (D) anal plates, X110; (E) derm pore arrangement near anal plates, X110; (F) antenna, X110; (G) derm pores more enlarged, X200.

This species was found only once on small magnolias at Fowler about August 5, 1915.

Genus TOUMEYELLA Cockerell.

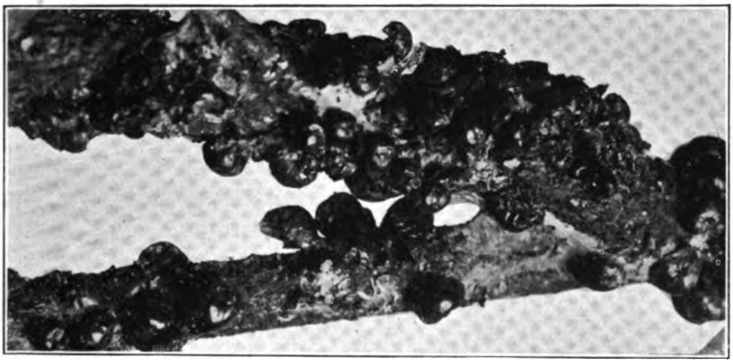
Female body circular to oval, strongly convex, surface often irregular; antennae and legs very much reduced, "rudimentary"; spiracular spines very short and stout, approximately equal in length; anal ring with 10 hairs; hypopygial setae present.

We have only one species in Indiana.

TOUMEYELLA LIRIODENDRI (Gmel.).

Coccus liriodendri Gmel. Syst. Nat. Ed. **13** (1789) p. 2220.

Eulecanium liriodendri (Gmel.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 190.



TOUMEYELLA LIRIODENDRI (Gmel.), slightly enlarged. (After Douglass.)

Toumeyella liriodendri (Gmel.), Sanders, Jour. Econ. Ent. **2** (1909) p. 447.

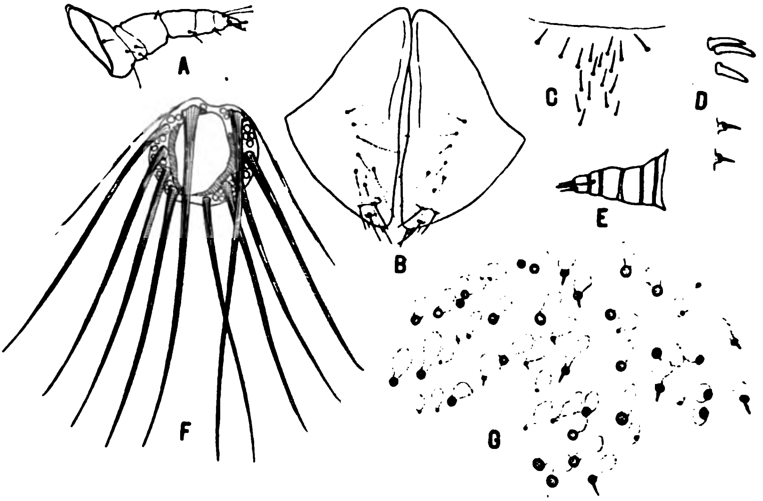
Eulecanium tulipiferae (Cook), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 177.

ADULT FEMALE: Rather large, largest diameter 4-7 mm.; nearly circular, strongly convex, surface irregular, fairly heavily chitinized with a heavily chitinized darker area surrounding the anal plates; antennae of the "rudimentary" type, sometimes indistinctly six segmented or less, with about 6 apical hairs and a single subapical hair; legs very short and stout, of the "rudimentary" type, empodial hairs variable, not longer than the tarsal claw; pores small, circular, widely scattered except around the anal plates, while two sizes of surface setae are scattered among the pores, the bases of both indicated by circles smaller than those of the pores; marginal spines small, stout, set in a distinct chitinous thickening; spiracular spines short, very stout, the median usually little if any longer than the outer pair; hypopygial setae present, about 16 in number; anal plates triangular, about twice as long as broad, the cephalo-lateral margins very distinctly longer

than the caudo-lateral; with one large fringe seta on each side, with the sub-apical setae forming an elongate cluster about seven in number, apical setae three in number; anal ring with ten hairs.

This species has been found in a few localities in the state and is usually a serious pest where it occurs. The records are Marion county, Cass county and Montgomery county (Douglass) and Floyd county and Harrison county. In all cases it was on yellow poplar or tulip tree (*Liriodendron tulipiferae*).

After a fairly careful comparative study of this and the preceding species, we do not believe that the two are generically distinct. We do not presume to comment on the validity of the two genera, however.



TOUMEYELLA LIRIODENDRI (Gmel.).

(A) middle leg, X110; (B) anal plates, X110; (C) hypopigial setae, X110; (D) marginal and spiracular spines, X110; (E) antenna, X110; (F) anal ring, X200; (G) derm pores and surface spines near anal plates, X110.

Genus LECANIUM Burmeister.

Female convex, circular to oval; legs and antennae fairly well developed; middle spiracular spine less than twice as long as the outer two, (except *nigrofasciatum*); anal ring with 8 hairs; hypopigial setae wanting.

We have found six species of this genus in the state.

KEY TO SPECIES.

A. Dorsum of adult female with a row of about thirty tiny conical appendages running cephalad from the anal plates; middle spiracular spine more than twice as long as the outer ones; derm pores not grouped .... *nigrofasciatum*

AA. Dorsum without such appendages; middle spiracular spine less than twice as long as the outer ones.

  B. Each anal plate distinctly more than twice as long as wide.

    C. Size very large, 10-13 mm.; derm pores scattered, not arranged in any definite order; found on hickory, etc.............. *caryae*

    CC. Size smaller, not more than 6 mm.; derm pores arranged in elongate groups radiating from the center, and separated by narrow bare ridges; dorsum with two more or less distinct humps; found only on *Crataegus* imported from Europe... *bituberculatum*

  BB. Each anal plate at most not more than twice as long as wide.

    C. Smallest spiracular spine distinctly less than twice as long as an average length marginal spine; derm pores more or less definitely arranged.

      D. Derm pores, at least near the middle of the body, large and arranged in single rows radiating from the center; surface of derm nearly smooth, not wrinkled or roughened; occurring only on Arbor-vitae.............................. *fletcheri*

      DD. Derm pores arranged in irregular rows radiating from the center of the body, pores small; surface of derm irregularly roughened and much more heavily chitinized than in preceding species; not occurring on conifers................. *corni*

    CC. Smallest spiracular spine at least distinctly twice as long as an average length marginal spine; derm pores scattered, not arranged in any apparent order; very convex, often approaching a globular form; on oaks................................ *quercifex*

LECANIUM NIGROFASCIATUM Pergande.

Lecanium nigrofasciatum Pergande, U. S. D. A. Bur. Ent. Bull. (n. s.) **18** (1898) p. 26.

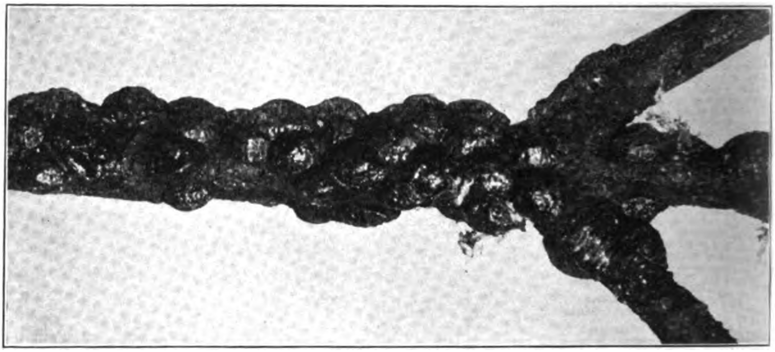
Eulecanium nigrofasciatum (Pergande), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 191.

Lecanium nigrofasciatum Pergande, Sanders, Jour. Econ. Ent. **2** (1909) p. 446.

Eulecanium nigrofasciatum (Pergande), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 175.

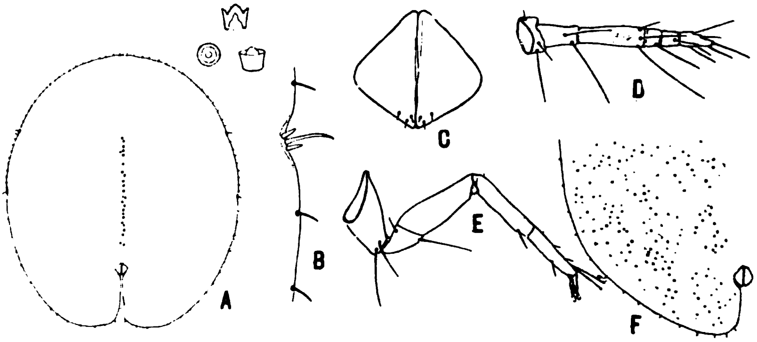
This description is copied from that of Thro (1903 p. 211).

ADULT FEMALE: Shape oval, broader posteriorly, and hemispherical; cuticle varying in color from light or dark red to black, with the median stripe lighter and with small clear areas each of which contains a very small dot; with a few small setae scattered on the dorsal surface; length 3-4 mm.; width 2.6 mm.; antennae with six segments, the third, which is the longest, having three setae; anal plate nine-sixteenths as broad as long with the cephalo-lateral and caudo-lateral margins sub-equal, with the lateral extremity and apex sharp, and with a faint scar close to cephalo-lateral margin near the lateral extremity; with two subapical and three apical setae, two of the latter on the outer lateral margin and one a slight distance from the apex; with four fringe setae in groups of two, the inner two one-half as long as the outer; middle spiracular seta broader at the apex than at the base, the other two slightly tapering; marginal setae short, hair-like and acuminate; on the dorsum with an irregular row of about thirty low, conical appendages extending along the meson in front of the plates.



LECANIUM NIGROFASCIATUM Pergande, enlarged. (After Douglass.)

We have only one definite record for this species, Muncie, May 24, 1915, on Norway maple. Douglass states that it was found in some localities in northern Indiana, always on silver or hard maple. It does not seem to be a pest in Indiana.

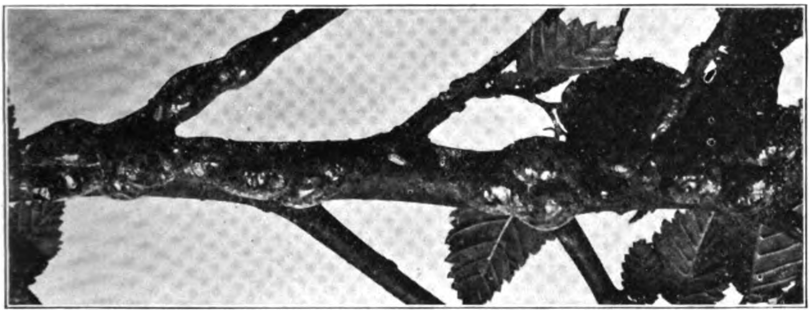


LECANIUM NIGROFASCIATUM Perg.

(A) outline of body showing dorsal tubercles in position, X17, and also the tubercles more enlarged, X200; (B) marginal and spiracular spines, X110; (C) anal plates, X110; (D) antenna, X110; (E) middle leg, X110; (F) derm pore arrangement, X30.

LECANIUM CARYAE Fitch.

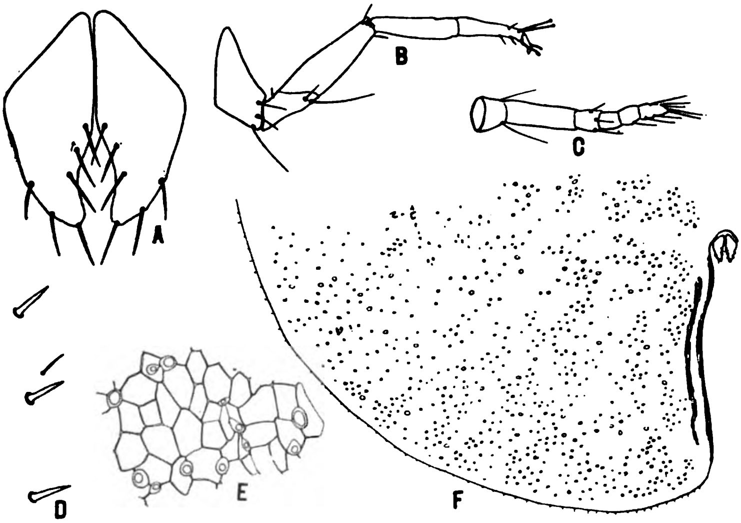
Lecanium caryae Fitch, Rpt. Ins. N. Y. **3** (1856) p. 125.
Eulecanium caryae (Fitch), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 183.



LECANIUM CARYAE Fitch, natural size. (After Douglass.)

Lecanium caryae Fitch, Sanders, Jour. Econ. Ent. **2** (1909) p. 442.
Eulecanium caryae (Fitch), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 170.

ADULT FEMALE: Very large, 10-13 mm.; nearly circular to elongate

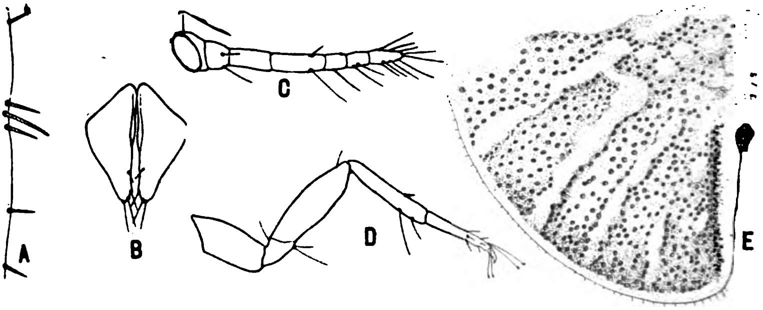


LECANIUM CARYAE Fitch.

(A) anal plates, X110; (B) middle leg, X110; (C) antenna, X110; (D) marginal spines, X110; (E) details of derm pore arrangement, X110; (F) derm pore arrangement, X17.

oval, typically short oval; color buff or yellow brown, changing to reddish brown after oviposition; rather heavily chitinized; with scattered pores of two sizes; the reticulations of the derm showing; antennae small, normally 6-7-segmented; legs small; marginal spines large and stout; spiracular spines not observed; anal plates small, long and slender, each nearly three times as long as broad, with about 6 rather large spines; apparently three fringe setae on on each side; anal ring with 8 hairs.

L. caryae has been found at and near Indianapolis, at New Albany, at Corydon, at Salem, at Bluffton and Muncie, scattered records indicating a wide distribution over the state. The hosts so far as we have observed are sycamore (1 record), black walnut (1 record) and elm, on which it was most abundant. These records include *L. cockerelli* of Hunter, which according to Sanders is simply a parasitized form of *L. caryae.*



LECANIUM BITUBERCULATUM Targ.

(A) marginal and spiracular spines, X110; (B) anal plates, X110; (C) antenna, X110; (D) hind leg, X110; (E) derm pore arrangement, X17.

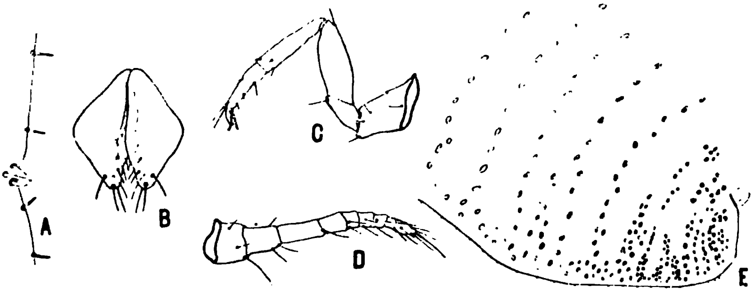
LECANIUM BITUBERCULATUM Targioni-Tozetti.

Lecanium bituberculatum Targ. Coccidarum Catalogus (1869) p. 38.

Eulecanium bituberculatum (Targ.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 182.

The following description is taken from Newstead (1902, p. 101):

ADULT FEMALE: Broadly ovate, highly convex, and evenly rounded in front, with two pairs of widely-separated subdorsal shining tubercles, the anterior pair being much the largest, and very conspicuous; the posterior pair, very small, and sometimes only faintly indicated, placed immediately behind the former; the body behind the tubercles usually slopes suddenly downwards to the anal cleft; median area between the marginal cleft and the tubercles more or less convex, usually with a deep depression radiating from the anal cleft on either side; margins at the sides with seven or eight equidistant, and more or less irregularly-raised carinae, the central carina on each side being much the strongest, and usually extending to the large anterior tubercles; margins of anal cleft raised and prominent. Color, chocolate-brown, chestnut-brown, or rarely greyish-brown or greenish-grey, with a varying number of interrupted transverse, ivory-white lines or bands, the anterior pair of bands being generally continuous on the dorsum, the rest gradually diminishing in length towards the anal cleft, while, in some examples, the white markings preponderate and partly obscure the ground color; margins between the carinae broadly greyish, or greyish-green; tubercles blackish-crimson or piceous, and with one or two pairs of white transverse bands, the anterior pair being usually the larger; these spots often very slightly raised above the dermis, and, viewed dorsally, appear as minute tubercles. Antennae usually of eight segments, but sometimes of seven and the comparative length of the segments varies; formula (3, 5), (4, 6, 7, 8) 2, 1, or 3 (4, 5, 6, 7, 8) 2, 1; the hairs are rather straight and stiff. Legs a little longer than the antennae, and slender; digitules to claw broadly dilated, with the extremities suddenly truncate, those of the claw ordinary. Anal plates rounded, with several long hairs on the apical portion. Spiracles circular, with inner basal attachment reticulated. Marginal spines simple, rather slender, and pointed.



LECANIUM FLETCHERI Ckll.
(A) marginal and spiracular spines, X110; (B) anal plates, X110; (C) middle leg, X110; (D) antenna, X110; (E) derm pore arrangement, X17.

Long, 4-6 mm.; wide, 3-4 mm.; high, 2-2.50 mm. Parasitised specimens smaller.

This insect has been found twice during the import inspection work of the past season, once at Indianapolis by Mr. M. E. Kimsey, a deputy of this office, and the second time at Columbus, in both cases on a species of *Crataegus* which we think is *oxycantha* imported into this country from Europe. Most of the specimens had died before oviposition, but three were found with masses of eggs beneath them.

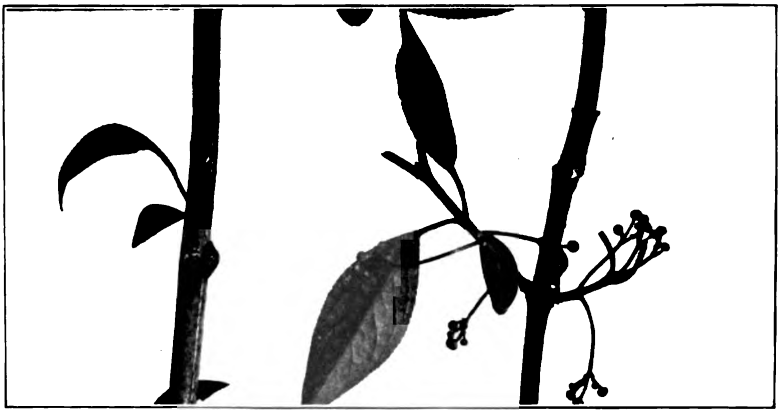
LECANIUM FLETCHERI Cockerell.

Lecanium fletcheri Cockerell, Can. Ent. **25** (1893) p. 221.

Eulecanium fletcheri (Ckll.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 187.

Eulecanium fletcheri (Ckll.) Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 173.

ADULT FEMALE: Small, largest diameter 3-5 mm.; shape almost globular; color light yellowish brown, darker in old specimens; not very heavily chitinized; antennae moderate, normally 8-segmented, the third segment longest; legs moderate in size; derm pores rather large, arranged in more or less definite, widely separated rows radiating from center to margin, this especially noticeable near the middle of the body, but somewhat variable; marginal spines small, fairly stout; middle spiracular spine less than twice as long as the other two, all rather short and stout; anal plates rather stout, hardly twice as long as wide, the cephalo-lateral margins slightly longer than the caudo-lateral; with four fringe setae, arranged in two pairs; with two subapical setae; with four apical setae; anal ring with 8 hairs.



LECANIUM CORNI Bouche, natural size. (After Douglass.)

This species has been found in two places around Indianapolis and at Muncie, in every case on Arbor Vitae.

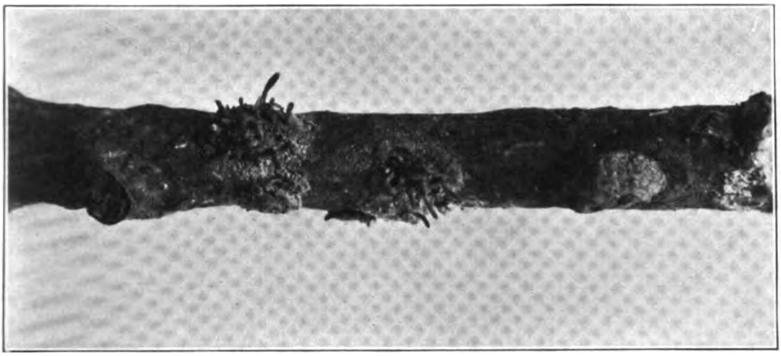
LECANIUM CORNI Bouche.

Lecanium corni Bouche, Stett. Ent. Zeitschr. **5** (1844) p. 298.

Lecanium corni Bouche, Sanders, Jour. Econ. Ent. **2** (1909) p. 443.

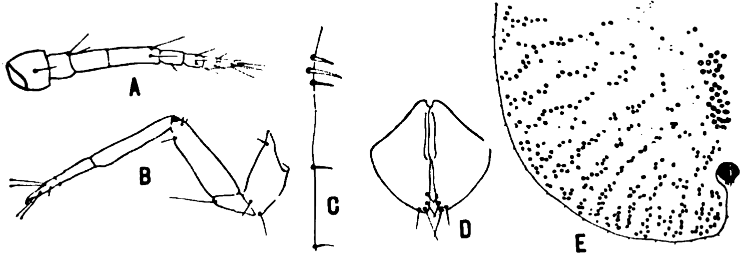
Eulecanium corni (Bouche), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 172

ADULT FEMALE: Largest diameter ranging from 3.5-6 mm.; shape circular to oval, strongly convex; old female dark brown, the margins showing a heavier chitinization than the dorsum; dorsum nearly smooth, but the surface strongly wrinkled near the margins; the wrinkles mostly parallel to the body margin; antennae fairly well developed, normally 7-segmented; legs fairly well developed; derm pores usually of two sizes, some apparently double or multiple, arranged in more or less definite but very irregular rows radiating from center to margin, this less pronounced in some specimens; also with a closely set elongate group of pores running cephalad from the anal plates; marginal spines rather short and stout, spiracular spines rather slender, the median not twice as long as the outer ones; anal plates broad, each plate a little less than twice as long as broad, caudo-lateral margin typically slightly longer than cephalo-lateral; with four fringe setae arranged in two pairs, with two subapical, and four apical setae on each plate; anal ring with eight hairs, two smaller than the others.



LECANIUM CORNI Bouche, attacked by fungus, enlarged. (After Douglass.)

We have found what we consider to be this species nearly every place in the state where we have looked for scale insects. It infests a wide variety of hosts, the following being some of



LECANIUM CORNI Bouche.

(A) antenna, X110; (B) leg, X110; (C) marginal and spiracular spines, X110; (D) anal plates, X110; (E) derm pore arrangement, X17.

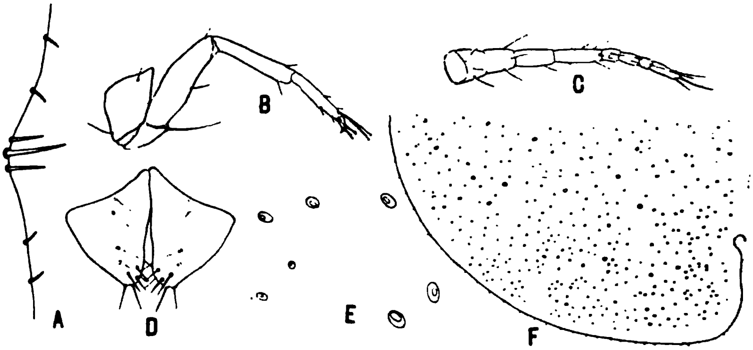
those recorded for Indiana: plum, pin oak (*Quercus palustris*), sweet gum (*Liquidambar styraciflua*), hackberry (*Celtis occidentalis*), basswood (*Tilia americana*), elm (*Ulmus americana*), euonymus, walnut (*Juglans* sp.), maple (*Acer saccharum and saccharinum*), etc. It occasionally becomes a serious pest.

LECANIUM QUERCIFEX Fitch.

Lecanium quercifex Fitch, Rept. Ins. N. Y. **5** (1858) p. 194.

Eulecanium quercifex (Fitch), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 194.

Lecanium quercifex Fitch, Sanders, Jour. Econ. Ent. **2** (1909) p. 445.



LECANIUM QUERCIFEX Fitch.
(A) marginal and spiracular spines, X110; (B) middle leg, X110; (C) antenna, X110; (D) anal plates, X110; (E) derm pores enlarged, X110; (F) derm pore arrangement, X17.

The following description is from Thro (1903, p. 213):

ADULT FEMALE: Shape elliptical, tapering slightly at both ends; dorsal cuticle dark brown, with small clear areas each of which contains a very small dot; length 4 mm.; width 3 mm.; antennae seven segmented, with the third and fourth subequal; anal plate slightly more than one half as broad as long, with the lateral margins subequal, and the lateral extremity and the apex rounded; with two subapical and four apical setae on each plate, with the latter clustered at the apex and the anterior seta one-ninth of the length of the plate from the apex; with four fringe setae, subequal in length, in groups of two; with short transverse rows of short striations on the hypopigium; all of the spiracular setae long and conical, with the first one of each group slightly over one-half as long as the middle one; most of the marginal setae short and blunt, with the longest less than one half as long as the first spiracular seta; oviparous.

We have only one definite record of this species in the state, at Noblesville, June and July, 1912, on white oak (*Quercus alba*).

Genus SAISSETIA Deplanches.

Adult female strongly convex, nearly hemispherical; derm closely crowded with large circular to oval pores; middle spiracular spine more than twice as long as the outer ones; anal ring with 8 hairs.

We have found two species in the state.

KEY TO SPECIES.

A. Adult female strongly hemispherical, very dark brown, with one longitudinal and two transverse ridges forming an H-shaped mark on the dorsum; derm with many large closely set pores; caudo-lateral margins of anal plates distinctly longer than cephalo-lateral...*oleae*

AA. Adult female hemispherical, lighter in color, without ridges; derm pores a little smaller and more widely separated; caudo-lateral margins of anal plates little if any longer than cephalo-lateral....*hemisphaerica*

SAISSETIA OLEAE (Bern.), enlarged. (After Douglass.)

SAISSETIA OLEAE (Bernard).

Chermes oleae Bern. Mem. Nat. Acad. Marseille (1872) p.108.

Saissetia oleae (Bern.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 205.

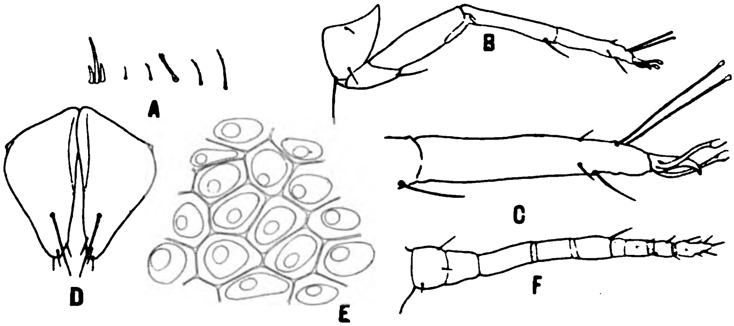
Saissetia olea (Bern.), Sanders, Jour. Econ. Ent. **2** (1909) p. 440.

Saissetia oleae (Bern.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 183.

The following description is taken from Thro (1903, p. 214):

ADULT FEMALE: Shape elliptical, dorsum very convex and with a median, longitudinal carina and two tranverse carinae; dorsal cuticle dark brown and compactly alveolate; length, 4-5 mm.; width 2 mm.; antennae eight segmented, with the third the longest, without setae on the third and fourth segments, with one long and two short setae on the fifth segment; anal plate almost twice as long as broad, with the cephalo-lateral margin two-thirds as long as the caudo-lateral, and the lateral extremity rounded; with four subapical, one discal, and three apical setae on each plate, with the longest one of the latter on the inner lateral margin; with eight fringe setae, of various lengths, in groups of four, with the inner one of each group about one-fourth as long as the outer one; median spiracular seta nearly four times as long as the first, and the first and third long and conical; some of the marginal setae short and acuminate, others serrated at the ends and others bifurcate; with several appendages on the margin.

S. oleae has been found in a few Indianapolis greenhouses, on *Ficus pandurata* and *F. elastica.*



SAISSETIA OLEAE (Bern.).
(A) marginal and spiracular spines, X110; (B) middle leg, X110; (C) tarsus of middle leg, X200; (D) anal plates, X110; (E) portion of derm, X110; (F) antenna, X110.

SAISSETIA HEMISPHAERICA (Targ.)

Lecanium hemisphaerica Targ., Studii sul Cocc. (1867) p. 26.

Saissetia hemisphaerica (Targ.), Fernald, Cat. Cocc., Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 202.

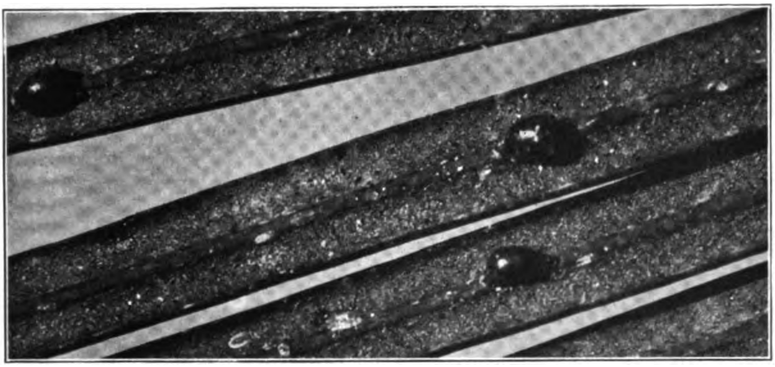
Saissetia hemisphaerica (Targ.), Sanders, Jour. Econ. Ent. **2** (1909) p. 439.

Saissetia hemisphaerica (Targ.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 182.

This description is copied from Thro (1903, p. 215).

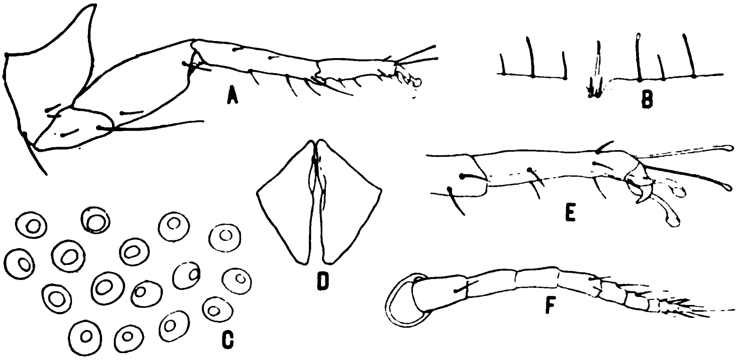
ADULT FEMALE: Shape elliptical, dorsum very convex; dorsal cuticle light or dark brown, and densely alveolate, although not to such an extent as *oleae*; length, 3-4 mm.; width, 3 mm.; antennae usually seven segmented but sometimes eight, with setae on all, the first segment with one long and two short setae, the third segment the longest; anal plate nearly twice as long as broad, with its cephalo-lateral margin four-fifths as long as its caudo-lateral, the lateral extremity of the plate angulate and the apex rounded; each plate with a discal seta, four subapical setae, and three apical setae,

with the one on the inner lateral margin longest; discal seta occasionally fringed at the apex; with eight fringe setae arranged in groups of four, with one in each group slightly over one-half as long as the others; middle seta of the spiracular group three times as long as the first, first and third long and conical; long marginal setae serrated at the ends, shorter ones acuminate; with many unicellular glands opening onto the ventral surface; oviparous, entire ventral body-wall becoming concave when the eggs are laid.



SAISSETIA HEMISPHERICA (Targ.), enlarged. (After Douglass.)

This is a common greenhouse scale insect, occurring on a considerable variety of hosts, particularly ferns, *Ficus*, chrysanthemum, etc. We have found it in Indianapolis, Ft. Wayne, Evansville, New Albany and South Bend.



SAISSETIA HEMISPHAERICA (Targ.).

(A) middle leg, X110; (B) marginal and spiracular spines, X110; (C) arrangement of derm pores, X110; (D) anal plates, X110; (E) tarsus of middle leg, X200; (F) antenna, X110.

Subfamily DIASPINAE.

Body of adult female covered by a scale composed of secreted wax and of cast larval skins; without legs or antennae; terminal segments of the abdomen united to form a flat sharp-edged compound segment or pygidium; without a hair-bearing ring surrounding the anus.

This subfamily is represented in Indiana by nine genera and thirty-three species.

KEY TO GENERA.

A. Without branched plates on the margins of any of the segments anterior to the pygidium.
  B. Scale of female elongate, narrowed in front, exuviae terminal.
    C. Without plates between the median lobes, the median lobes either close together or deeply sunken in the apex of the pygidium, the inner margins joining each other at the base; scale of male small, elongate, sides parallel or nearly so, distinctly felted, nearly always uni- or tricarinate, white; scale of female broad, white (except *Hemichionaspis*).
      D. Median lobes more or less sunken in the body, strongly divergent, leaving a distinct notch on the median line. . *Phenacaspis*
      DD. Median lobes not sunken into the body, not strongly divergent.
        E. Median lobes with their inner margins very close together or touching throughout their length; scale of female brown . . . . *Hemichionaspis*
        EE. Median lobes with their inner margins more or less strongly divergent before their apex, the bases close together or touching, scale of female white . . . . *Chionaspis*
    CC. With a pair of distinct plates between the median lobes, the latter widely separated and protruding, not sunken in the apex of the pygidium; scale of male similar to that of female, but smaller, both very long and slender, usually dark brown in color . . . . *Lepidosaphes*
  BB. Scale of female circular to oval.
    C. Median lobes sunken into the apex of the pygidium, strongly divergent, the inner margins crenulate; with two small spines but without plates between the median lobes; scale of male elongate, slender, small, tricarinate, exuviae terminal.
      D. Dorsal tubular gland openings arranged in distinct rows; inner margins of median lobes close together at base; scale of female circular or broadly pyriform, exuviae marginal or submarginal . . . . *Aulacaspis*
      DD. Dorsal tubular gland openings scattered, not arranged in distinct rows; median lobes rather widely separated; scale of female circular to oval, exuviae subcentral to submarginal. . . . . *Diaspis*
    CC. Median lobes protruding from the apex of the pygidium, not sunken, the inner margins not strongly divergent nor crenulate; with a pair of more or less distinct plates between the median lobes; scale of male similar to that of female, but smaller.

D. Chitinous thickenings extending anteriorly from the apex of the pygidium either short and stout or wanting, never with more than two in a single group................. *Aspidiotus*

DD. Chitinous thickenings long, slender, in one species with at least one group of three on each side............... *Chrysomphalus*

AA. With branched plates on some of the segments anterior to the pygidium; scale of female varying from circular to elongate, exuviae marginal; scale of male elongate, parallel-sided, not carinated, exuvia terminal; median lobes not sunken, widely separated, and with a pair of large branched plates between them........................ *Parlatoria*

Genus CHIONASPIS Sign.

SCALE OF FEMALE: Narrow in front, more or less broadened behind, white, exuviae terminal at the cephalic end.

SCALE OF MALE: Small, elongate, slender, sides parallel or nearly so, white, nearly always tricarinate, exuvia terminal at cephalic end.

BODY OF FEMALE: Shape of the body elongate, broadened posteriorly, body distinctly segmented with more or less distinct rows of oval gland orifices on the dorsal surface between the posterior segments of the abdomen anterior to the pygidium and a group of gland spines both of which are more distinct near pygidium than anteriorly; each side of the abdominal segments with a group of nearly circular gland orifices.

PYGIDIUM OF FEMALE: With at least two pairs of well developed lobes, the inner margins of the median lobes diverging for at least part of their length; the second and the third, when present, cleft to form two lobules; without incisions or chitinous thickenings; plates wanting, replaced by gland spines which are grouped as follows on each side of the median line: 1, 1-2, 1-2, 1-2, 1-9; anal opening small, at least a little nearer to the base than the apex of the pygidium; circumgenital gland openings numerous, arranged in five groups; marginal pores present, arranged as follows on each side of median line: 1, 1-2, 2, and sometimes 1-2 marginal or submarginal; dorsal glands present, arranged in 2-3 rows, these rows usually broken up into two groups; some small gland openings which appear to be micropores present.

KEY TO SPECIES.

A. Median lobes with their inner margins parallel for much of their length and apparently fused in some specimens; chitinous thickening between the median lobes long and slender............. *americana*

AA. Inner margins of median lobes more divergent, at least near the tips.

B. Median lobes distinctly fused for about half of their length; median chitinous thickening large and clavate .... *caryae*

BB. Median lobes at most fused only at the base.

C. Inner margins of median lobes parallel and very close together at base, then widely divergent diagonally, and straight so the outer angles of the lobes are the longest .... *corni*

CC. Inner margins of median lobes rounded, not so strongly divergent.

D. Space between each median lobe and the first lobule of the second lobe equal or nearly equal to the width of the median lobe; median notch wide and deep .... *pinifoliae*

DD. Median lobes wider, the second lobes nearer the median than the width of the median, notch between median lobes much narrower.

E. Median lobes rather short and broad; inner margins very close together and almost parallel for much of their length, then rather sharply divergent to the broadly rounded caudal margins; lobules of the second and third lobes more or less obliquely pointed .... *furfura*

EE. Median lobes not as above; lobules of the second and third lobes not tending to form an oblique point.

F. Male scale distinctly carinated; space between median lobes and the inner lobule of the second lobe equal to at least half the width of the lobule.

G. Median lobes prominent and somewhat crenulate along the margins; inner lobule of the second lobe relatively long; chitinous thickening between median lobes slender, lanceolate .... *gleditsiae*

GG. Median lobes broad and short, rounded at tips; inner lobule of the second lobes shorter and stouter; chitinous thickening between median lobes very broad and stout .... *salicis-nigrae*

FF. Male scale not carinated; space between median lobes and the inner lobule of each second lobe equal to about one-third the width of the lobule .... *ortholobis*

CHIONASPIS AMERICANA Johnson.

Chionaspis americana John. Ent. News **VII** (1896) p. 150.

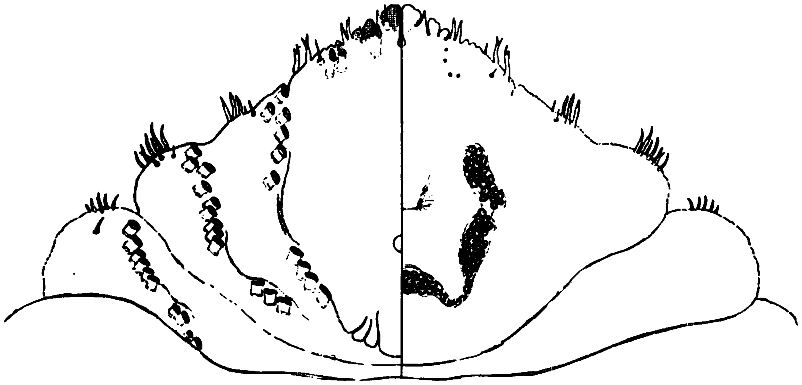
Chionaspis americana John. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 213.

Chionaspis americana John. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 185.

SCALE OF FEMALE: Length 2-3.2 mm.; normally uniformly broadened from the apex, widest beyond the middle, rather dense, color normally pure white but often obscured and hidden by dirt, particularly on specimens found in the larger cities; exuviae brown in color, often concealed by the grayish or blackish secretion, about one-half the total length of the scale; ventral scale rather thin and delicate, white.

SCALE OF MALE: Length about 1 mm.; elongate, slender, sides subparallel, distinctly tricarinate, white, exuvia pale yellow, about two-fifths of the total length of the scale.

PYGIDIUM OF FEMALE: Medium, outline broadly triangular, not heavily chitinized; with two pairs of well developed lobes, the third pair more or less distinctly developed, median lobes large, strongly projecting beyond the pygidial margin, inner margins parallel and very close together for much of their length, sometimes partly fused, apex rounded, outer margin deeply and distinctly notched about its middle, second lobes deeply and distinctly cleft to form two lobules, the inner very much larger than the outer, pointing diagonally inwards and notched on its outer margin, third lobes incised to form two more or less distinct lobules; with an elongate club-shaped thickening running cephalad from between the median lobes; no plates, gland spines as follows: 1 on each side of median lobes and 1-2 between the second and third lobes, 2, often branched at tip, beyond third lobes, then 2-4, and last near the base of the pygidium a group of 4-7; anal opening circular, closer to base than to apex of pygidium; circumgenital gland openings in 5 groups, as follows in specimens examined: median 16-30. anterior laterals 17-29, posterior laterals 20-24; marginal gland openings as follows: 1 between median and second lobes, 1 near the inner margin of third lobe, and a third just laterad of it on third lobe, fourth outside of the next pair of gland spines beyond the third lobe, the last about half way between the last two groups o gland spines; only the two outer rows of dorsal gland openings present, eac of two groups, inner or third row with the posterior group 4-5, anterior grou 4-6, the outer or fourth row with posterior group 5-8, anterior group 3-5 micropores so far as observed shown in figure.



Pygidium of CHIONASPIS AMERICANA John.

Our records show that this species is scattered over practically the entire state. The hosts so far as reported are *Ulmus americana* and red haw (*Crataegus coccinea*). In some cases this species is proving to be a serious pest of young elms.

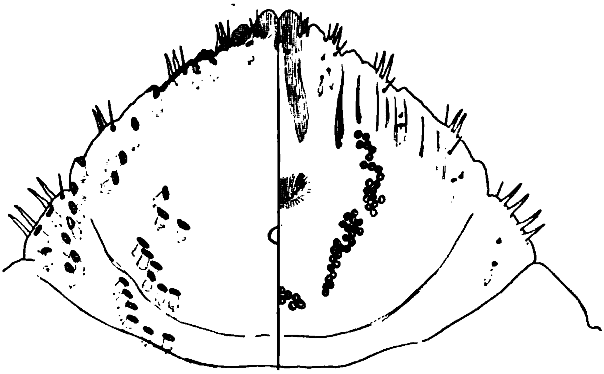
CHIONASPIS CARYAE Cooley.

Chionaspis caryae Cooley, Can. Ent. **30** (1898) p. 86.
Chionaspis caryae Cooley, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 214.

SCALE OF FEMALE: Length 1.7-2 mm.; irregular in shape, rather dense, rather convex, dirty white, inconspicuous; exuviae .7 mm. long, first plainly visible, second almost hidden by secretion.

SCALE OF MALE: Length .5-.7 mm.; oblong to elliptical with a distinct median carina; exuvia brown, about one-third the length of the scale.

PYGIDIUM OF FEMALE: With two pairs of well developed lobes, the third somewhat developed, median lobes large, broad, distinctly fused along the median line to beyond the middle, margins entire, second and third lobes cleft to form two lobules, the inner larger and more prominent in each lobe, margins of lobules more or less serrate; gland spines arranged as follows: 1, 1, 1-2, 1-2, 5-7; anal opening small, nearer to base than to apex of pygidium; circumgenital gland openings arranged in five groups as follows: median 10-19, anterior laterals 20-29, posterior laterals 15-22; marginal gland openings as follows: 1, 2, 2, 1; dorsal gland openings in three rows, the inner represented by the anterior group consisting of 1-4, the middle row of two groups, the posterior of 3-5, the anterior of 4-6, outer row of two groups, the posterior of 4-5, the anterior of 4-6; micropores so far as observed shown in figure.



Pygidium of CHIONASPIS CARYAE Cooley.

We have only one record for this species, Vincennes, Feb. 26, 1914, sent to this office by Mr. W. C. Reed. The host according to Mr. Reed was black walnut (*Juglans nigra*).

CHIONASPIS CORNI Cooley.

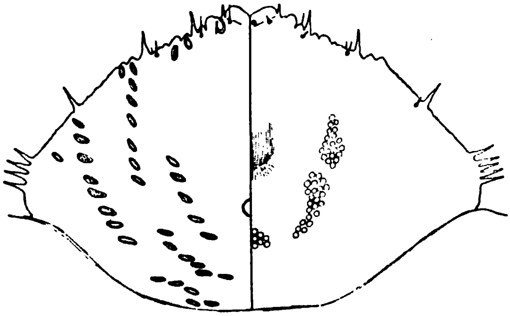
Chionaspis corni Cooley, Mass. Hatch Exp. Sta. Spec. Bull. (1899) p. 15.

Chionaspis corni Cooley, Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 215.

Chionaspis corni Cooley, Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 187.

SCALE OF FEMALE: Length 1.6-2 mm.; shape rather irregular, distinctly broadened behind, rather delicate in texture, white; exuviae bright orange yellow to brown in color, about .7 mm. long.

SCALE OF MALE: Length .6-.8 mm.; moderately but distinctly tricarinate, a pale yellow exuvia occupying about one third of the length of the scale.



Pygidium of CHIONASPIS CORNI Cooley.

PYGIDIUM OF FEMALE: Size medium, not heavily chitinized, almost semicircular; median lobes prominent, fused for about half their length, then strongly divergent, inner margin almost straight to a somewhat pointed outer angle, usually entire, broad and rather short and stout; inner lobules of second and third lobes entire, rounded and more prominent than the outer lobules; no incisions; no thickenings of the apical margins of the pygidium; no plates, gland spines as follows: 1, 1, 1-2, 1-2, 4-6; anal opening nearer the base of the pygidium than the apex; circumgenital gland openings in 5 groups, the median 9-16, anterior laterals 17-28, posterior laterals 10-20; marginal gland openings as follows: 1, 2, 2, 1; dorsal gland openings in three rows, the first wanting, the second or the inner row represented by the anterior group of 2-5, third or middle row in two groups, the posterior of 5-7, anterior of 4-5, fourth or outer row in two groups, the posterior of 6-9, anterior 4-7.

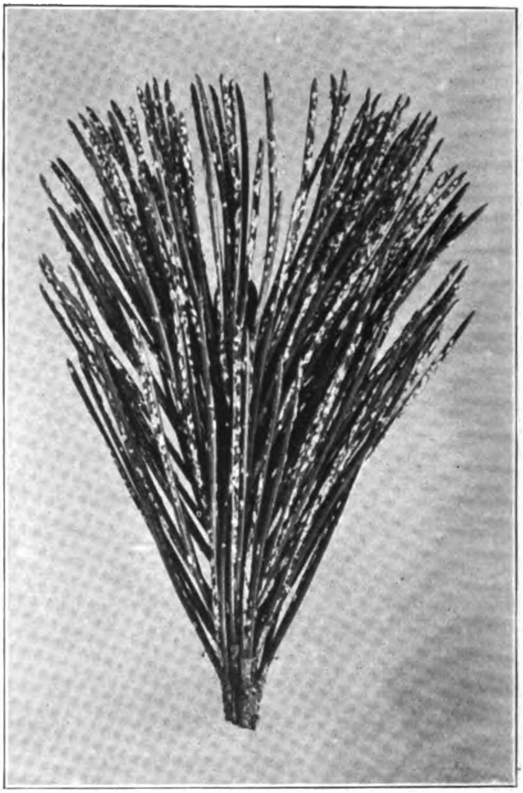
We have not had specimens of this species for study and the description and figure are made from those of Cooley and Sanders. The species was reported from northern Indiana on *Cornus alternifolia* by Mr. B. W. Douglass and was not considered of economic importance.

CHIONASPIS PINIFOLIAE (Fitch).

Aspidiotus pinifoliae Fitch, Second Rpt. Ins. N. Y. (1855), p. 488.

Chionaspis pinifoliae (Fitch), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 221.

Chionaspis pinifoliae (Fitch), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 190.



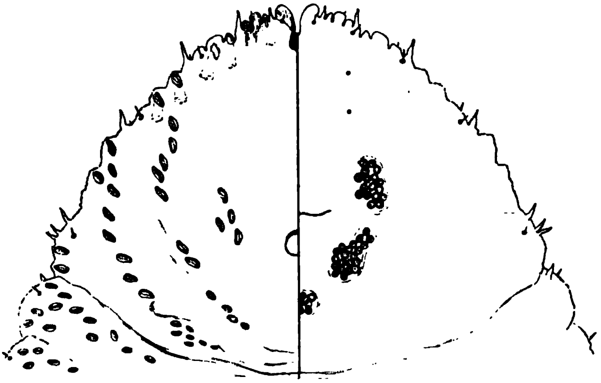
CHIONASPIS PINIFOLIAE (Fitch). **Females on pine needles. (After Douglass.)**

SCALE OF FEMALE: **Length about 3 mm.; more elongate and slender than the other species of *Chionaspis*; fairly dense, rather strongly convex, normally pure white in color but often dirty white; ventral scale very thin and inconspicuous.**

SCALE OF MALE: **Length about 1 mm.; elongate, narrow, sides nearly parallel, but slightly broadened behind, tricarinate, white; exuvia pale yellow, about one third the whole length of the scale.**

PYGIDIUM OF FEMALE: **Rather large, circular to oval, with three**

pairs of fairly well developed lobes, the median sunken into the apex of the pygidium, plainly separated, the inner margins parallel near the base, then gradually diverging, the apices rounded, not very broad, second lobes distinctly notched, forming two lobules, the inner larger and a little less prominent than the median lobes, third lobes distinct, the inner lobule broad and short; with an almost circular chitinous thickening, notched caudally, between the median lobes; gland spines arranged as follows: 1, 1, 1, 1, 1-3; anal opening distinctly nearer to the base than the apex of the pygidium, circular; circumgenital gland openings in five groups, as follows in specimens examined: median 7-8, anterior laterals 14-18, posterior laterals 14-18; marginal gland openings as follows: 1, 2, 2, 2; dorsal gland openings in three rows, the first only wanting, second or inner row represented only by the anterior group of 3-4, third or middle row represented by two groups the posterior of 4-7, anterior of 2-3 large openings and 3-4 smaller ones cephalad of the larger ones, outer or fourth row represented by two groups, the posterior of 7-8, anterior group of 4-7 smaller openings; micropores so far as observed shown in figure.



Pygidium of CHIONASPIS PINIFOLIAE (Fitch).

Our records show that this species has been found in scattered localities in the central and southern part of the state and it seems probable that it will be found generally over the state in those places where pines have been introduced. It is occasionally of some economic importance but no really successful control has been suggested.

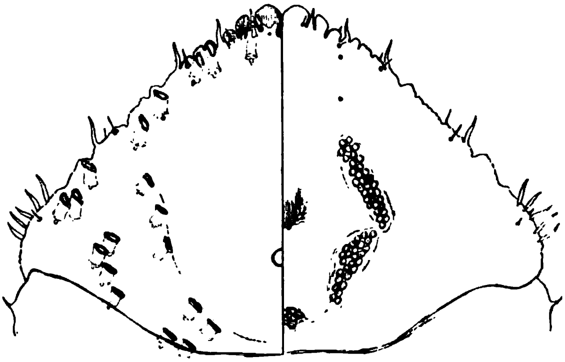
CHIONASPIS FURFURA (Fitch).

Aspidiotus furfura Fitch, Third. Rpt. Nox. & Ben. Ins. N. Y. (1856) p. 352.

Chionaspis furfura (Fitch), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 217.

Chionaspis furfura (Fitch), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 188.

SCALE OF FEMALE: Length 2-3 mm.; broad and stout, sometimes almost oval, flat, rather thin, color normally pure white but often dirty gray and sometimes almost exactly resembling the bark on which it rests; exuviae small, yellowish brown and often completely hidden by dirty gray secretion, about one-fourth the total length of the scale; ventral scale very thin.



Pygidium of CHIONASPIS FURFURA (Fitch).

SCALE OF MALE: Length about .8 mm.; elongate, narrow, sides almost parallel, surface roughened, distinctly tricarinate; exuvia pale yellow, about one-third the entire length of the scale.

PYGIDIUM OF FEMALE: Rather large, broadly triangular in outline; with two pairs of well developed lobes, median large, broad, prominent, inner margins parallel for some of their length, apices more or less triangular, not notched, second lobes cleft to form two distinct lobules, the inner much larger and somewhat inclined toward the median lobes, its caudo-lateral margin sometimes indistinctly serrate, third lobes indistinctly developed more or less notched in the middle; with a somewhat oval chitinous thickening between the bases of the median lobes; with the gland spines grouped as follows: 1, 1, 1, 1, 4-9; circumgenital gland openings arranged in three groups, variable, about as follows: median 8-12, anterior laterals 22-23, posterior laterals 16-28; marginal gland openings grouped as follows: 1, 1-2, 2, 1; dorsal gland openings in two rows, the inner two missing, each row arranged in two groups, about as shown in figure, but variable; micropores so far as observed shown in figure.

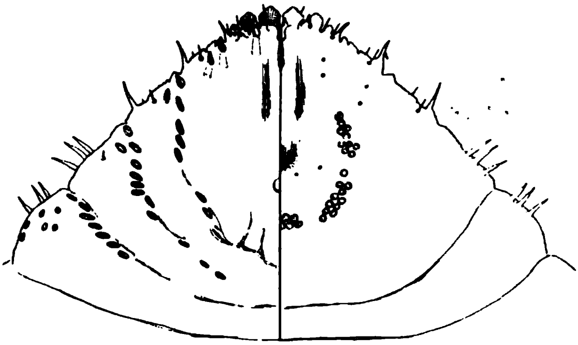
This scale may be found in old and neglected orchards nearly any place in the state. The hosts recorded from Indiana are apple and pear. Usually it is not a serious pest, but occasionally it becomes serious.

CHIONASPIS GLEDITSIAE Sanders.

Chionaspis gleditsiae Sanders, Ohio Nat. **3** (1903) p. 413.

SCALE OF FEMALE: Length 1.5 to 2 mm.; shape irregular, usually very broad posteriorly, somewhat convex; texture rather firm, color dirty white, ventral scale conspicuous, white.

SCALE OF MALE: Length .6-.8 mm.; elongate, parallel-sided, strongly carinate; exuvia pale yellow, about one fourth the total length of the scale.



Pygidium of CHIONASPIS GLEDITSIAE Sanders.

PYGIDIUM OF FEMALE: More or less triangular, apex rounded; median lobes broad for their basal half then tapering sharply and serrate, inner margins parallel, fused at base, second lobes cleft into two distinct lobules, the inner much larger and spatulate, inclined towards the median lobes, third lobes very rudimentary, indistinctly cleft, margin serrate; with a somewhat club-shaped chitinous thickening running cephalad from between the bases of the median lobes; gland spines as follows: 1, 1, 1, 1, 3-5; anal opening distinctly nearer base than apex of pygidium; circumgenital gland openings in five groups, as follows in specimens examined: median 9, anterior laterals 14-19, posterior laterals 8-14; marginal gland openings grouped as follows: 1, 2, 2, 2; only third and fourth rows of dorsal gland openings present, posterior group of third row of 4, anterior group of 2-5, fourth row with posterior group of 7-9; micropores so far as observed shown in figure.

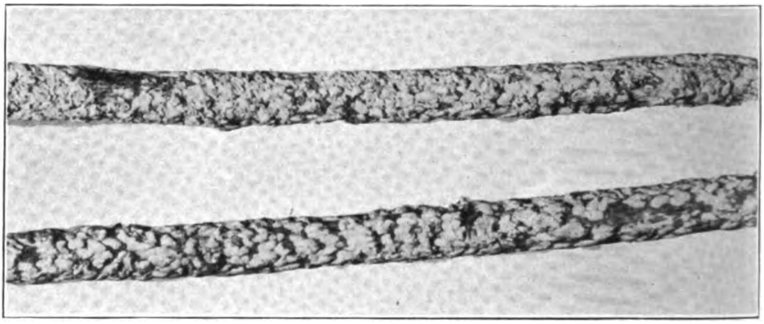
This species was found only once, at Vincennes, Aug. 3, 1915, on Honey locust (*Gleditsia triacanthos*). It was mixed in with specimens of *Phenacaspis spinicola* D. & M. and its identity was not discovered until mounts were made.

CHIONASPIS SALICIS-NIGRAE (Walsh).

Aspidiotus salicis-nigrae Walsh, First Rpt. Ins. Ill. (1867) p. 39.

Chionaspis salicis-nigrae (Walsh), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 225.

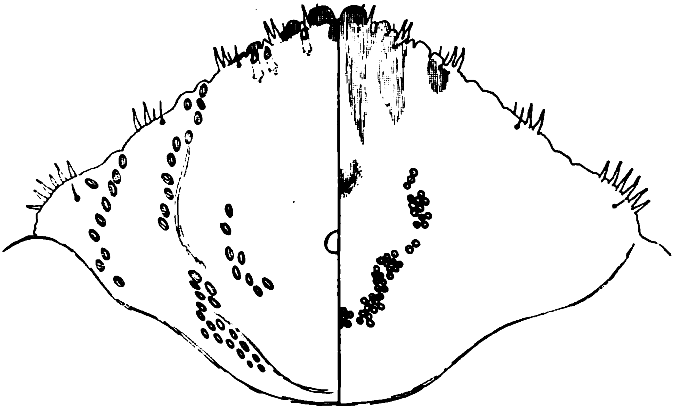
Chionaspis salicis-nigrae (Walsh), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 193.



CHIONASPIS SALICIS-NIGRAE (Walsh), natural size. (After Douglass.)

SCALE OF FEMALE: Length 3-4 mm.; shape variable, usually moderately elongated and broadest near the middle, strongly convex, color white; exuviae usually light brown, about .8-.9 mm. long; ventral scale relatively heavy, white, remaining attached to the dorsal scale in some specimens.

SCALE OF MALE: Length about 1 mm.; elongate, slender, sides slightly rounded, distinctly but feebly tricarinate; exuvia usually pale brown, about one-third the total length of the scale.



Pygidium of CHIONASPIS SALICIS-NIGRAE (Walsh).

PYGIDIUM OF FEMALE: Broad and stout, apex broadly triangular, with three pairs of lobes, the median broad, rounded, entire or serrate, not contiguous except at base, inner lobule of second lobes much larger and more prominent than outer, inner lobules of third lobes much larger, and somewhat more prominent than outer; with a broad stout chitinous thickening between the median lobes, this with two notches in the caudal margin; gland spines as follows: 1, 1-2, 1-2, 1-3, 4-6; anal opening circular, nearer base than apex of pygidium; circumgenital gland openings in five groups, number variable, as follows in specimens examined: median 22-24, anterior laterals 19-25, posterior laterals 19-24; marginal gland openings as follows: 1, 2, 2, 1; dorsal gland openings present in the three outer rows, inner or second row represented by the anterior group of 3-8, middle or third row in two groups, the posterior 5-8, anterior group of 6-9 large and several small openings, fourth or outer row of two groups, the posterior of 8-9 and some smaller ones, the anterior not discernible, given as 6-10; ventral thickenings and micropores, so far as observed, shown in figure.

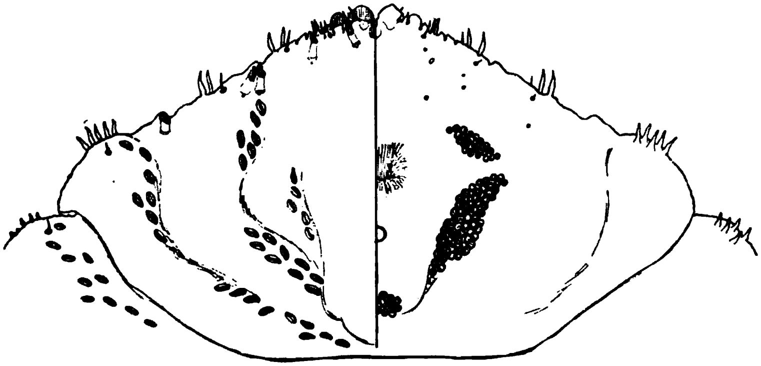
We have actual records for this species only from Hammond and from below Indianapolis, in both cases from an undetermined species of willow (*Salix*). According to Douglass, the species is sometimes found in various parts of the state on native willows. The species sometimes becomes of economic importance.

CHIONASPIS ORTHOLOBIS Comstock.

Chionaspis ortholobis Comst. Rpt. U. S. Dept. Agric. for 1880 (1881) p. 317.

Chionaspis ortholobis Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 221.

Chionaspis ortholobis Comst. Morrison & Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 75.



Pygidium of CHIONASPIS ORTHOLOBIS Comst.

SCALE OF FEMALE: Length 2-2.5 mm.; broadly ovate, somewhat elongate, irregular in shape where crowded, dirty white or in fresh specimens on the living bark almost exactly the color and appearance of the bark; exuviae pale brown, about .8 mm. long; ventral scale distinct, fairly heavy, thicker along the margins of the scale.

SCALE OF MALE: Length .6 to .8 mm.; very elongate, oval; exuvia pale brown, or almost colorless, about one-third of the total length of the scale; carinae entirely lacking.

PYGIDIUM OF FEMALE: Large, almost oval in shape; with two pairs of well developed lobes, the third slightly developed, median broad, not very long, inner margins contiguous at base, lobes more or less uniformly rounded at apex, varying to almost triangular or with a tiny projecting tubercle at apex, second lobes divided into two broad and stout lobules, the outer much smaller, third lobes feebly developed, slightly notched; with a broad stout chitinous thickening between the median lobes; gland spines grouped as follows: 1, 1-2, 1-2, 2, 4-5; anal opening slightly nearer base than apex of pygidium; circumgenital gland openings in five groups, quite variable, as follows in specimens examined: median 21-22, anterior laterals 30-31, posterior laterals 26-31; marginal gland openings grouped as follows: 1, 2, 2, 1; dorsal gland openings present in three rows, only the inner missing, second row with only the anterior group of 3-5 present, third or middle row in two groups, posterior of 6-8, anterior 8-9, fourth or outer row in two groups, posterior 7-9, anterior 9; micropores so far as observed shown in figure.

So far we have found this species only on sycamore (*Platanus occidentalis*) in the city of Indianapolis and near Vincennes. It does not appear to be of any economic importance.

Genus HEMICHIONASPIS Cockerell.

SCALE OF FEMALE: Similar to *Chionaspis*, but brown.

SCALE OF MALE: Similar to *Chionaspis*, tricarinate.

BODY OF FEMALE: Similar to *Chionaspis*.

PYGIDIUM OF FEMALE: Almost like *Chionaspis* but with the inner margins of the median lobes parallel for their entire length and very close together.

HEMICHIONASPIS ASPIDISTRAE (Signoret).

Chionaspis aspidistrae Sign. Ann. Soc. Ent. Fr. (4), **IX** (1869) p. 443.

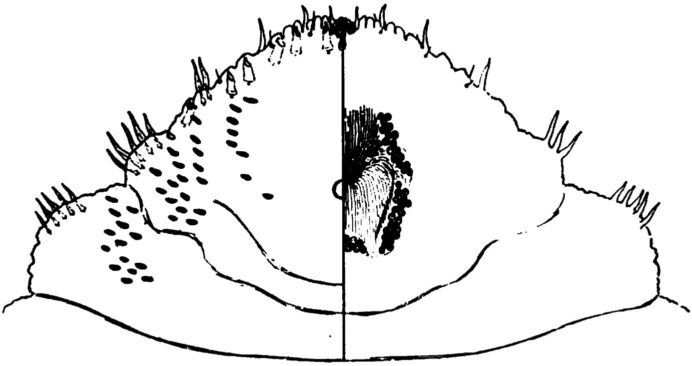
Hemichionaspis aspidistrae (Sign.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 239.

Hemichionaspis aspidistrae (Sign.) Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 193.

SCALE OF FEMALE: Length about 2-2.5 mm.; shape usually rather irregular, but distinctly broadened behind, with the caudal extremity rounded, thin and delicate, semitransparent, although this is also variable, flat, pale brown in color; exuviae about .8 mm. long, similar in color to the scale; ventral scale thin and semitransparent.

SCALE OF MALE: Length about 1-1.2 mm.; elongate, slender, sides nearly parallel, distinct and prominently tricarinate, white; exuvia pale yellow, about one-fifth to one-fourth the total length of the scale.

PYGIDIUM OF FEMALE: Size medium, apex rather broadly rounded; median lobes well developed, projecting from the apex of the pygidium, inner margins parallel and close together for their entire length, the outer margins with two or three distinct notches, the two lobes forming a semicircle, second lobes well developed, split into two spatulate lobules, the inner nearly as prominent as the median lobes, third pair of lobes developed; without incisions; edges of second lobes thickened at base; gland spines: one just beyond each lobe, then one or two and then three to five near the base of the pygidium; anal opening circular, nearer base than apex of pygidium; circumgenital gland openings in five groups, variable, in specimens examined: median 13-14, anterior laterals 25-27, posterior laterals 23-24; marginal gland openings as follows: first on a large prominent projection between the median lobes and inner lobule of the second lobe, second on a prominent projection between the second gland spine and the inner lobule of the third lobe, third opening in what appears to be the outer lobule of the third lobe, fourth opening in a projection just beyond the third gland spine, fifth just beyond the fourth, sixth a little beyond the fourth gland spine, seventh, submarginal, opening just in front of large group of pygidial gland spines; dorsal gland openings about as shown in figure, somewhat variable; micropores, so far as observed, indicated in figure.



Pygidium of HEMICHIONASPIS ASPIDISTRAE (Sign).

From our records it seems probable that this species is generally distributed through the greenhouses of the state. It has been found on *Aspidistra*, *Pteris* and *Nephrolepis*. This species is of economic importance and is very difficult to control successfully.

Genus PHENACASPIS Cooley and Cockerell.

SCALE OF FEMALE: Similar to *Chionaspis.*

SCALE OF MALE: Similar to *Chionaspis,* tricarinate.

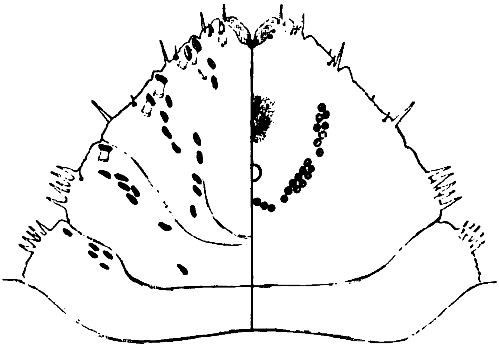
BODY OF FEMALE: Similar to *Chionaspis.*

PYGIDIUM OF FEMALE: Very similar to *Chionaspis,* but with the median lobes well separated, invaginated into the apical margin of the pygidium, with a deep notch between them, and with the inner margins strongly diverging.

KEY TO SPECIES.

A. Median lobes rather narrow, strongly divergent from the bottom of the triangular notch; lobules of the second lobes short and broad .... *nyssae*

AA. Median lobes broader, the inner margins parallel at base and diverging less strongly, enclosing a narrow median notch; lobules of the second lobes longer and more slender, usually distinctly more prominent than the median lobes.................................*spinicola*



Pygidium of PHENACASPIS NYSSAE (Comstock).

PHENACASPIS NYSSAE (Comstock).

Chionaspis nyssae Comst. Rept. U. S. Dept. Agr. 1880 (1881) p. 316.

Phencaspis nyssae (Comst.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 239.

SCALE OF FEMALE: **Length 1-1.5 mm.; usually strongly broadened behind, almost triangular, flat, snowy white, delicate; exuviae nearly one-half the total length of the scale in some cases; ventral scale very thin and delicate, hardly visible.**

SCALE OF MALE: Length 1-1.25 mm.; elongate, slender, parallel-sided, snow white, distinctly tricarinate; exuvia from one-fifth to one-third the total length of the scale.

PYGIDIUM OF FEMALE: Large, rather elongate, somewhat triangular, the sides nearly straight; median lobes large, long and narrow, deeply sunken into the body, strongly diverging from the base, leaving a broad triangular median notch, outer margins slightly concave, inner margins slightly convex, joined together at base by a heavy chitinous thickening, finely serrate on inner margins, second lobes well developed, divided into two lobules, the inner very much larger and more prominent than the outer, third and fourth lobes not evidently developed; margin of pygidium beyond the second lobes finely serrate; without incisions or chitinous thickenings along the posterior margin of the pygidium; without plates, gland spines as follows: one just outside of each median lobe, second just outside the outer lobule of second lobe, third beyond rudiments of third lobe, fourth almost half way between third and base of pygidium, then a group of two to five close to the base of the pygidium; anal opening circular, somewhat nearer to the base than to the apex of the pygidium; circumgenital gland openings in five groups, fairly constant, in specimens examined as follows: median 6, anterior laterals 10-11, posterior laterals 8; marginal gland openings as follows: first between median and second lobes, second on a slight prominence outside of second gland spine, third opening just in front of inner lobule of rudimentary third lobe, fourth on a slight protuberance well beyond the third gland spine, fifth a little beyond the fourth, submarginal, sixth about half way between fourth gland spine and group of gland spines; dorsal gland openings about as indicated in figure; micropores, so far as observed, indicated in figure.

This species has been found only once in the state, at Vincennes, Aug. 31, 1915, on the leaves of sour gum (*Nyssa sylvatica*).

PHENACASPIS SPINICOLA Dietz & Morrison.

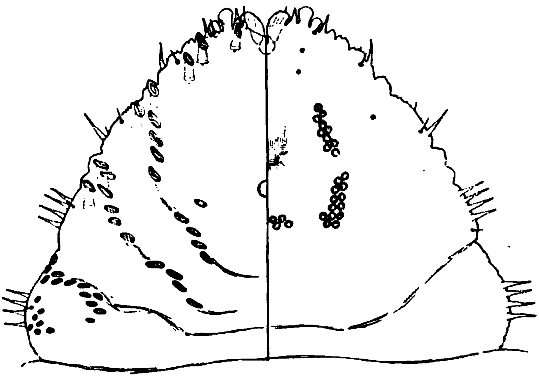
Phenacaspis spinicola Dietz & Morrison, Ent. News **27** (1916) p. 101.

SCALE OF FEMALE: Length 1.5-2 mm.; strongly broadened behind, widest behind the middle, apex broadly rounded, sometimes more irregular in shape, thin, somewhat convex; color normally white but often gray or dirty gray; exuviae large, occupying fully one third of the total length of the scale, the first pale brown and shiny, the second very light yellow and dull; ventral scale well developed along the edges, very thin or wanting in the center, often remaining attached to the dorsal scale.

SCALE OF MALE: Length about .8 mm.; elongate, narrow, sides approximately parallel or slightly curved; white, more or less distinctly tricarinate, roughened above; exuvia, pale yellow, occupying fully two-fifths of the total length of the scale.

BODY OF FEMALE: Elongate, narrow, broader just in front of the pygidium, distinctly segmented, cephalic segment almost triangular, apex rounded, the two segments preceding the penultimate segment more or less distinctly constricted at the sutures.

PYGIDIUM OF FEMALE: Rather large, parabolic in shape, deeply incised at apex by the sunken median lobes; median lobes large, deeply sunken into the pygidium, broad, the outer margin nearly straight, then angularly curved to the median chitinous thickenings, inner margins strongly curved from base to apex, close together and parallel for a short distance at base, distinctly crenulate, second lobes distinctly divided into spatulate lobules, the inner more prominent than the median lobes, inner lobule of third lobes well developed, but broad, only slightly projecting, with serrate margin; no incisions in the margin of the pygidium; with a more or less distinctly hexagonal thickening on the median line at the base of the median lobes, this deeply notched caudally; no plates present, gland spines as follows: one just outside median lobe, one just outside of the outer lobule of the second lobe, one beyond the rudimentary outer lobule of the third lobe, one about half way between this and the base of the pygidium, and a group of two to four just caudad of the base of the pygidium; spines as shown in figure; anal opening circular, slightly nearer to base than to apex of pygidium; circumgenital gland openings arranged in five groups, median 8-9, anterior laterals 10-15, posterior laterals 7-10; marginal gland openings as follows: one between the first and second lobes on a slight prominence, one on a slight prominence between second gland spine and inner lobule of third lobe, one just beyond this, opening at the outer angle of the inner lobule of the third lobe, one, the first of a row, on a slight prominence a little beyond the third gland spine, one a little beyond this, a little inside of the margin, apparently opening into a pocket, one on a slight protuberance beyond the fourth gland spine and the last a little beyond this; dorsal gland openings somewhat variable, but about as shown in figure; micropores, so far as observed, as follows: two, one in front of the other, cephalad of the outer lobule of the second lobes, one close to the second gland opening of the first row of dorsal gland openings.



Pygidium of PHENACASPIS SPINICOLA D. & M.

This species has been found in two places just outside of Indianapolis, Sept. 15, 1915, and in two places east of Vincennes.

Aug. 31, 1915, in all cases on the honey locust (*Gleditsia triacanthos*), infesting especially the green spines on the trunk of the tree, but also to some extent the bark, twigs and leaves. In all cases it was scarce, and cannot be considered as being of economic importance.

Genus LEPIDOSAPHES Shimer.

SCALE OF FEMALE: Elongate, slender, more or less distinctly broadened behind, some shade of brown; exuviae terminal at cephalic end.

SCALE OF MALE: Similar to that of female but smaller and with a hinge-like constriction on posterior third.

BODY OF FEMALE: Elongate, broadened posteriorly, pyriform; color ranging from pale yellowish white in *L. beckii* and *ulmi* to pale purple with yellow pygidium in *L. gloverii;* body distinctly segmented, each of the last two to four abdominal segments bearing a group of from 2-5 prominent gland spines on each margin and one or more setae among these; dorsal pores small, oval, numerous and scattered.

PYGIDIUM OF FEMALE: With two pairs of well developed lobes, the median large and broad, strongly projecting from the apex of the pygidium, widely separated and with a pair of gland spines between them, second pair of lobes cleft to form two lobules, the inner the larger; no incisions or chitinous thickenings present; gland spines arranged as follows on each side of the median line: two between median lobes, 2, 2, 2, 2; anal opening small, relatively very close to base of pygidium; circumgenital gland openings numerous, arranged in five groups; marginal gland openings present, arranged as follows on each side of median line: 1, 2, 2, 1; dorsal gland openings present, arranged in 2-3 rows; ventral thickenings distinct.

KEY TO SPECIES.

A. Penultimate segment of the body with two, rarely three marginal gland spines on each side; median lobes somewhat longer and more slender than in the following species, more or less distinctly notched on each side .... *gloverii*

AA. Penultimate segment of the body with four or more marginal gland spines on each side; median lobes shorter and broader.

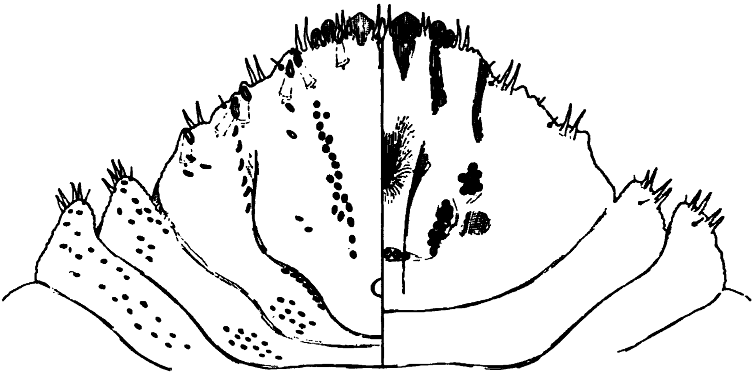
  B. Median lobes not distinctly notched on each side, apex triangular; both lobules of each second lobe rather long, the outer only a little smaller than the inner.................................. *beckii*

  BB. Median lobes distinctly notched on each side, apex broadly rounded; outer lobule of each second lobe much smaller than the inner.*ulmi*

LEPIDOSAPHES BECKII (Newman).

Coccus beckii Newm. The Entomologist, 4 (1869) p. 217.
Lepidosaphes beckii (Newm.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. 88 (1903) p. 305.
Lepidosaphes beckii (Newm.) Douglass, Fourth Rpt. Ind. St. Ent. 1911) p. 221.

SCALE OF FEMALE: Length about 3 mm.; elongate, slender, normally nearly straight, but often curved when crowded, broadened behind, only slightly convex, fairly dense, purplish brown in color; exuviae concolorous with or slightly paler than the scale, about 1 mm. long; ventral scale well developed, usually remaining attached to the dorsal scale, continuous, or with a narrow irregular open space along the median line.



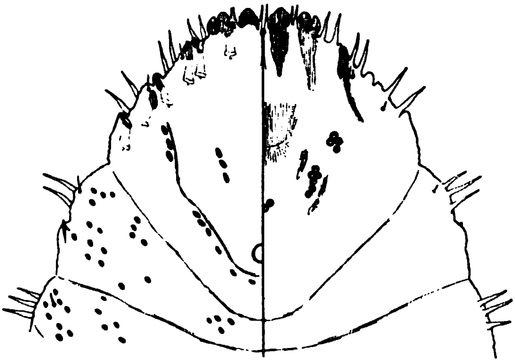
Pygidium of LEPIDOSAPHES BECKII (Newm.).

SCALE OF MALE: Length about 1.5 mm.; nearly straight, narrower and smaller than that of female; color about the same or a little lighter; posterior third with an indistinct hinge.

BODY OF FEMALE: Penultimate abdominal segment with four to five marginal gland spines on each margin.

PYGIDIUM OF FEMALE: Medium in size, not very heavily chitinized; median lobes large, broad, strongly projecting, converging to form a triangular apex, crenulate, second lobes less prominent than median distinctly cleft to form two lobules, the inner more prominent, third lobes somewhat developed, inner lobule notched slightly about the middle; no plates, gland spines arranged as follows: two between the median lobes, two between median and second, two between second and third, two beyond the third lobes, and two more about half way between these and the base of the pygidium; anal opening circular, much nearer to base than to apex, circumgenital gland openings arranged in five groups, median 5-7, anterior laterals 12-15, posterior laterals 8-11 in specimens examined; marginal gland openings as follows: one between median and second lobes, one just inside of third lobe, and one just beyond it on third lobe, a pair on a slight prominence placed where the fourth lobe should be, one on a slight projection beyond the fifth pair of gland spines; dorsal gland openings about as shown in figure, the large elongate inner group the most noticeable, ranging from 16-20; with thickenings of the pygidium extending cephalad from the first and second pairs of lobes.

This species is often shipped into the state on citrus fruits from the south, but so far as we know it has not become established here. All of our records are from Indianapolis.



Pygidium of LEPIDOSAPHES GLOVERII (Pack.).

LEPIDOSAPHES GLOVERII (Packard).

Coccus gloverii Packard, Guide to Study of Ins. Ed. 1 (1869) p. 527.

Lepidosaphes gloverii (Pack.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. 88 (1903) p. 309.

SCALE OF FEMALE: Quite similar to that of *L. beckii*, but more slender and usually more variable in color; the ventral scale completely separated into two halves along the median line.

SCALE OF MALE: Similar to that of *L. beckii*, but more slender.

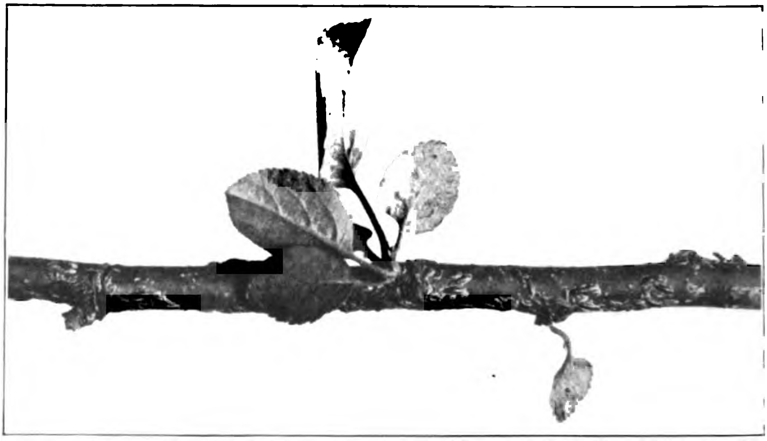
PYGIDIUM OF FEMALE: Very similar to *L. beckii*, except for the following differences: median lobes more or less distinctly notched on both margins, not serrate; corresponding gland spines larger and more prominent than in *L. beckii*, with two to three on the margin of the penultimate segment; circumgenital gland openings less numerous in each group; inner group of dorsal gland openings much fewer, 2-4.

We have found this only once, on grape-fruit said to have come from Florida and shipped into Indianapolis.

LEPIDOSAPHES ULMI (Linn.).

Coccus ulmi Linn. Syst. Nat. Ed. **X** (1758) p. 455.
Lepidosaphes ulmi (Linn.), Fernald, Cat. Cocc., Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 314.
Lepidosaphes ulmi (Linn.) Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 222.

SCALE OF FEMALE: Length about 2.5-3 mm.; normally elongate, slender, broadened behind, often distorted where crowded, caudal extremity rounded, dense, rather thick, convex; color usually chestnut brown but often darker; exuviae about .9 mm. in length, somewhat lighter brown than the scale; ventral scale rather well developed especially along the sides, the margins often remaining attached to the edges of the dorsal scale; scale of the female more or less distinctly divided into two areas by a curved transverse line, the cephalic portion smoother and more uniform in texture than the caudal which shows numerous transverse curved lines, giving the scale an appearance somewhat resembling that of an oyster shell.

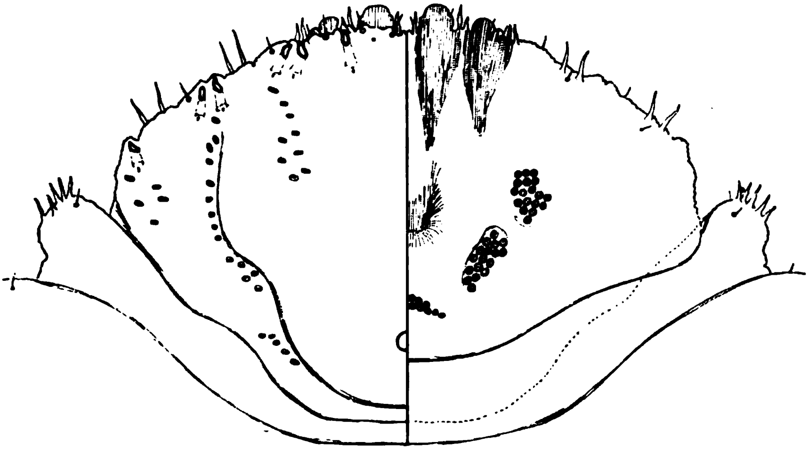


LEPIDOSAPHES ULMI (Linn.). natural size. (After Douglass.)

SCALE OF MALE: Length about 1.5 mm.; very closely resembling that of the female except much smaller, the hinge-like stricture mentioned above much more prominent and distinct.

PYGIDIUM OF FEMALE: Rather large, apex broadly rounded, rather heavily chitinized; median lobes very broad, rather short, projecting from apex of pygidium, deeply notched on both margins, apex broadly rounded, margins parallel near the base, second lobes cleft to form two distinct lobules, the inner much larger and more prominent, broadly spatulate, third lobes rudimentary; incisions and chitinous thickenings of the pygidial margin wanting; no plates, gland spines as follows: two between the median lobes, two between the first and second lobes, the outer much smaller, two between the second and third lobes, two beyond the rudimentary third lobes, and two half way between these and the base of the pygidium; in some cases only one spine is discernible at these last points, but we assume that the second one has been broken off; anal opening circular, much nearer the base than the apex of the pygidium; circumgenital gland openings in five groups, variable, as follows in specimens examined: median 10-14, anterior laterals 10-17, posterior laterals 11-18; marginal gland openings as described in detail for *L. beckii* and shown in figure; dorsal gland openings about as shown in figure.

This species is one of the commonest scale pests of the state and is widely distributed through it. In Indiana it has been observed on the following hosts: apple, horse chestnut, willow, Carolina poplar, walnut, lilac, pear, peony, cut-leaf maple, and red ozier dogwood.



Pygidium of LEPIDOSAPHES ULMI (Linn).

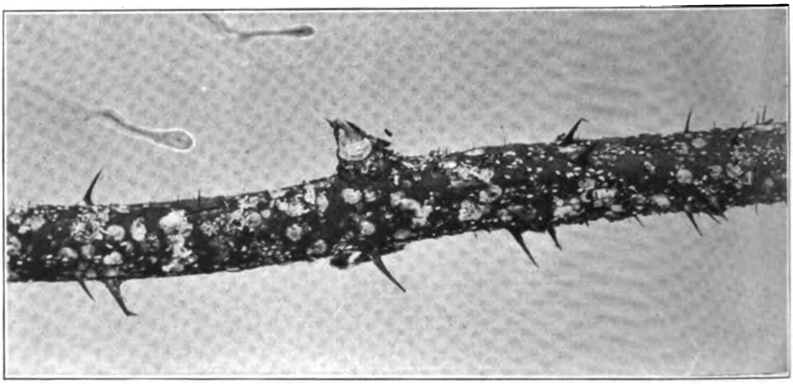
Genus AULACASPIS Cockerell.

SCALE OF FEMALE: Circular to oval, white, exuviae marginal or submarginal.

SCALE OF MALE: Similar to that of *Chionaspis*, tricarinate.

BODY OF FEMALE: Body elongate, ovate, tapering posteriorly; color reddish brown; cephalothorax equal to at least one-third to one-half the size of the whole body; abdomen distinctly segmented, with a row of dorsal oval gland openings between the posterior segments, these segments also with a group of gland spines on each side.

PYGIDIUM OF FEMALE: With three pairs of well developed lobes, the median deeply invaginated into the apex of the pygidium, widely separated, with the inner margins diverging and serrate, second and third lobes each cleft to form two lobules; without incisions or chitinous thickenings; gland spines present, arranged as follows on each side of the median line: 1, 1, 1, 1, 2-4; anal opening small, about half-way between base and apex of pygidium; circumgenital gland openings numerous, arranged in five groups; marginal glands present, arranged as follows on each side of the median line: 1, 2, 2, 2, one submarginal; dorsal gland openings arranged in three rows, the outer two divided into two groups.



AULACASPIS ROSAE (Bouche), natural size.

AULACASPIS ROSAE (Bouche).

Aspidiotus rosae Bouche, Naturg. Ins. (1834) p. 14.

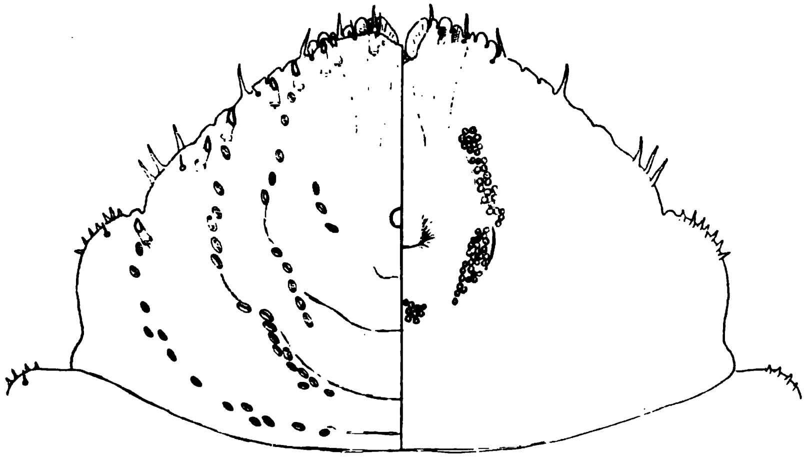
Aulacaspis rosae (Bouche), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 236.

Aulacaspis rosae (Bouche), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 193.

SCALE OF FEMALE: Diameter 2-3 mm.; circular or oval, somewhat irregular when crowded, rather thin, slightly convex; exuviae marginal or submarginal; color white, often rather dirty white, sometimes with a light pinkish tinge where the red body of the female and the eggs show through; exuviae dull yellow brown in color; ventral scale moderately dense, white, thicker near the edges.

SCALE OF MALE: Length 1-1.4 mm.; elongate, narrow, parallel-sided or very slightly broadened behind, distinctly tricarinate; exuvia terminal, about one-fourth the entire length of the scale, brown in color.

PYGIDIUM OF FEMALE: Size medium, margin broadly rounded to faintly angular, not heavily chitinized; with three pairs of well developed lobes, the two outer pairs deeply cleft to form two distinct rounded lobules projecting from the pygidial margin, median lobes deeply sunk into the apex of the pygidium, only the apices projecting, long, rather narrow, inner margins distinctly separated, parallel at base, then somewhat angularly diverging from each other to the rounded apex, crenulate, lobes united basally by a chitinous thickening of the apex of the pygidium, at least the inner lobule of the second lobes more prominent than the median lobes, fourth lobe very obscure, also notched; no incisions nor chitinous thickenings in the margin of the pygidium; no plates present, gland spines as follows: first outside each median lobe, one just beyond the outer lobule of second lobe, one beyond the outer lobule of the third lobe, one beyond the outer lobule of the rudimentary fourth lobe, a group of two to four near the penultimate segment, with about eight gland spines on each margin of the penultimate segment, this variable; anal opening about half way between the base and apex of pygidium, circular, small; circumgenital gland openings arranged in five groups, number in each group very variable, in specimens examined ranging as follows: median 17-25, anterior laterals 25-29, posterior laterals 24-29, the five groups forming an almost continuous horseshoe-shaped band; marginal gland openings with apices protruding, one between the median and second lobes, one between the second and third lobes, one just anterior to the inner lobule of each third lobe, one between the third and rudimentary fourth lobes, and two, the second a little within the margin, between the fourth lobe and the group of gland spines; dorsal gland openings distinctly arranged in rows, number variable, but about as shown in figure.



Pygidium of AULACASPIS ROSAE (Bouche).

Records indicate that this species is scattered over the whole state. It occasionally becomes serious, but control measures if promptly applied are usually very successful. The hosts reported from Indiana are several varieties of rose, blackberry, and red and black raspberry.

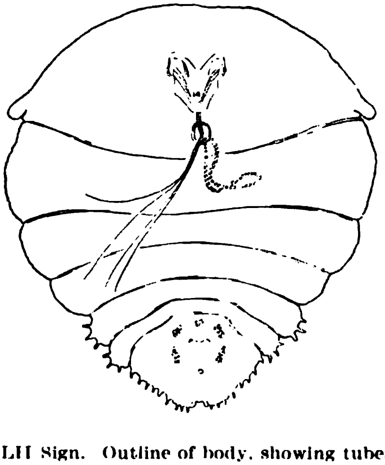
Genus DIASPIS Costa.

SCALE OF FEMALE: Circular or subcircular, dirty white or pale yellow; exuviae subcentral, at least not marginal.

SCALE OF MALE: Small, elongate, approximately parallel-sided, white, felted, tricarinate; exuvia terminal at cephalic end.

BODY OF FEMALE: Body almost oval in shape; color yellowish, varying with age, tinged with reddish or brownish; cephalothorax pronounced, about one-third to one-half the size of body, bearing in *D. boisdvalii* a prominent tubercle; segmentation of the abdomen rather indistinct; dorsal glands few and small and scattered along the sides of the posterior segments; gland spines few and prominent, placed in a row along the margin of the posterior segments.

PYGIDIUM OF FEMALE: With three pairs of well developed lobes, the fourth obscurely developed, the median widely separated, deeply sunken into the apex of the pygidium, the inner margins serrate, the second and third lobes each cleft to form two lobules; without incisions or chitinous thickenings; gland spines arranged as follows on each side of median line: 1, 1, 1, 2, 4; anal opening small, somewhat nearer to the apex than the base of the pygidium; circumgenital gland openings fairly numerous, arranged in five groups; marginal gland openings present, arranged as follows on each side of the median line: 1 between median lobes, 1, 2, 2, 1; dorsal gland openings present, not arranged in distinct rows, but scattered.



DIASPIS BOISDUVALII Sign. Outline of body, showing tubercles on cephalothorax.

DIASPIS BOISDUVALII Signoret.

Diaspis boisduvalii Sign., Ann. Soc. Ent. Fr. Ser. 4, Vol. 9 (1869) p. 432.

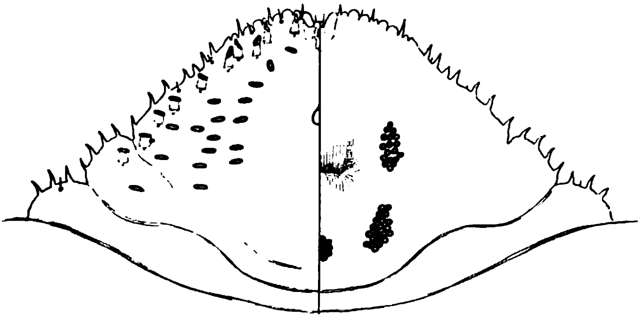
Diaspis boisduvalii Sign. Fernald, Cat Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 228.

SCALE OF FEMALE: Diameter 1.3-2.2 mm.; approximately circular to somewhat ovate, thin, semitransparent, whitish, somewhat wax-like in appearance, very flat; exuviae very pale yellow, central or subcentral, large; ventral scale very thin, transparent, hardly visible.

SCALE OF MALE: Length about 1 mm.; elongate, slender, distinctly tricarinate, roughened above, white, exactly resembling those of the genus *Chionaspis.*

BODY OF FEMALE: Cephalothorax with each caudo-lateral angle produced into a more or less distinct tubercle.

PYGIDIUM OF FEMALE: Rather small, sides nearly straight, converging diagonally, apex broadly rounded, almost truncate; median lobes widely separated, deeply sunken into the apex of the pygidium, leaving a prominent notch, median lobes elongate, diverging slightly from the base, outer margin nearly straight, inner gradually and more or less uniformly curved from base to apex, crenulate, second pair of lobes deeply incised, divided into two lobules, the inner more prominent, and a little more prominent than the median lobes, third pair of lobes also divided into two lobules, the inner more prominent, fourth lobes very obscure, margins somewhat serrate; without incisions between the lobes; with one gland spine outside of each of the four lobes, followed by a single one which just precedes a notch in the margin which is in turn followed immediately by a stout triangular spine which appears to be a process of the body wall, and following this three or four well separated gland spines; with two small parallel spines near the bottom of the notch between the median lobes, other spines as shown in figure; anal opening nearer the apex of the pygidium than to the base; circumgenital gland openings in five groups, variable, in specimens examined: median 8-10, anterior laterals 16-19, posterior laterals 12-15; marginal gland



Pygidium of DIASPIS BOISDUVALII Sign.

openings projecting beyond the pygidial margin, prominent, one between median lobes, one between first and second, one between second and third lobes, one just in front of the first lobule of third lobe, one between third gland spine and fourth lobe, one just in front of inner lobule of fourth lobe, one just in front of triangular marginal projection; the dorsal gland openings somewhat variable, but arranged as shown in figure.

Our records indicate that this greenhouse species is scattered over the state, as we have found it in greenhouses in many of the larger towns. The hosts for Indiana are various palms (*Washingtonia*, *Phoenix*, *Kentia*) and an orchid (*Cattleya*).

Genus ASPIDIOTUS Bouche.

SCALE OF FEMALE: Circular or approximately so, color variable, exuviae central or subcentral.

SCALE OF MALE: Similar to that of female, smaller and usually more oval, often darker in color.

BODY OF FEMALE: Circular to oval, with the pygidium more or less produced beyond the body outline; color usually bright yellow in fresh individuals; cephalothorax prominent, comprising one-fourth to one-half of entire body; segmentation distinct; segments anterior to the pygidium without gland spines or plates although in some, e. g. *A. cyanophylli* there are prominent setae; dorsal gland openings not numerous nor conspicuous in our species.

PYGIDIUM OF FEMALE: With from one to three pairs of well developed lobes projecting from the margin of the pygidium, the inner usually larger and more prominent and more or less distinctly notched at least on the outer margin; incisions with thickened edges present or wanting; short chitinous thickenings, arranged in pairs, sometimes present; plates present, usually more or less branched; anal opening varying in size, but always much nearer to apex than to base of pygidium; circumgenital gland openings present or absent, when present arranged in four to five groups, few in number; dorsal gland openings present, arranged in more or less distinct rows; basal and ventral thickenings usually evident; micropores usually evident.

KEY TO SPECIES.

A. Circumgenital gland openings wanting.

B. With three pairs of well developed lobes; plates large, conspicuous, deeply furcate.........................*Chrysomphalus aurantii*

BB. With less than three pairs of well developed lobes.

C. Plates small, inconspicuous, not deeply furcate nor crowded towards the median lobes; chitinous thickenings of inner incisions subequal in length; second pair of lobes fairly well developed .... *perniciosus*

CC. Plates large, more conspicuous, deeply furcate, crowded towards the median lobes; median lobes only well developed.

D. Chitinous processes of first incision subequal in length; plates deeply furcate.................................*rapax*

DD. Inner chitinous thickenings of first incisions much larger and longer than the outer, clavate in shape; plates long and spine-like ....*ulmi*

AA. Circumgenital gland openings present in adult female, arranged in four or five groups.

B. Elongated thickenings or incisions with thickened edges wanting or very indistinct.

C. Median lobes large, second and third pairs much smaller...... .... *cyanophylli*

CC. Median lobes only a little larger than the second pair.

D. All the lobes stout and broad, the two inner pairs distinctly notched on both inner and outer sides; dorsal tubular gland openings relatively small, but the gland tubes long. *britannicus*

DD. Lobes, particularly the second and third pairs, more slender and longer, only the median distinctly notched on both sides; dorsal tubular gland openings larger, but the gland tubes less than half as long as in the preceding species........*hederae*

BB. Distinct elongated thickenings or incisions with thickened edges present on the posterior margin of the pygidium.

C. Second pair of lobes larger, well developed, nearly as long to distinctly longer than the median; plates large, distinctly and strongly branched............................. *comstocki*

CC. Second pair of lobes not very well developed, much less prominent than the median; plates relatively small.

D. With four to five large, strongly branched plates immediately beyond each median lobe; only the median lobes well developed, broad and prominent, distinctly notched on the outer side; inner chitinous thickening of first incision little if any larger than the outer............................*lataniae*

DD. With not more than two plates immediately beyond each median lobe.

E. Inner angle of each third lobe distinctly developed, so three pairs of lobes are more less distinctly visible; inner chitinous thickening of first incision longer and much larger than the outer; plates small and inconspicuous, simple or bifid; dorsal gland openings relatively more numerous........ ....*juglans-regiae*

EE. Third lobes completely lacking.

F. Second pair of lobes fairly well developed, so two pairs of lobes are present; inner chitinous thickening of the first incisions much larger and somewhat longer than outer .... *forbesi*

FF. Median lobes only developed; chitinous thickenings of first incision approximately equal in length, the inner usually only a little thicker than the outer.

G. Median lobes lobes normally notched only on the outer side, more rarely on both inner and outer sides, stouter and broader, inner margins parallel or usually converging slightly towards the apex, the lobes not much narrowed towards the tip...................... *ancylus*

GG. Median lobes normally notched on both sides, that on the inner margin distinct, lobes more slender and both sides converging towards the apex so the lobe is plainly narrowed, inner margins parallel toward the base, or divergent .... *uvae*

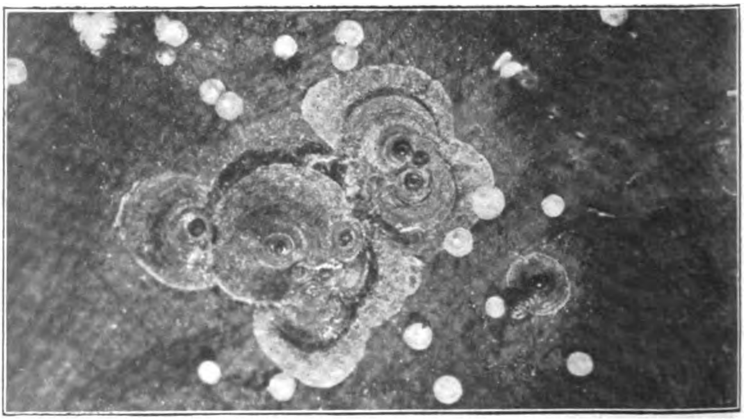
ASPIDIOTUS PERNICIOSUS Comstock.

Aspidiotus perniciosus Comstock, Rept. U. S. D. A. for 1880 (1881) p. 304.

Aspidiotus perniciosus Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 271

Aspidiotus perniciosus Comst. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 204.

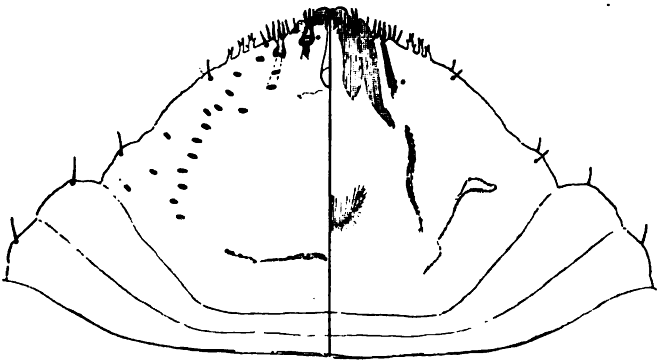
SCALE OF FEMALE: Diameter 1-2 mm.; circular, slightly convex centrally, gray, except portion covering the exuviae which varies from pale to reddish yellow; exuviae central or subcentral.



ASPIDIOTUS PERNICIOSUS Comst., enlarged.

SCALE OF MALE: **Oblong oval, nearly twice as long as wide, about 1 mm. long on the average; usually darker than female, sometimes black.**

PYGIDIUM OF FEMALE: **Size medium, with two pairs of well developed lobes, the median prominent, rounded at apex and notched about midway on outer margin, rarely notched on inner margin, converging slightly, second lobes smaller and narrower, close to median, notched on outer margin, converging somewhat; with stout chitinous thickenings bounding the two incisions on each side of the median line; with two inconspicuous plates between the median lobes, two between the median and second lobes, three laterad of the second lobes, these last laterally serrate; with 1-3 projections of the body wall laterad of the third spine; anal opening relatively close to apex of pygidium; circumgenital gland openings wanting; dorsal gland openings in three rows, about as shown in figure, but variable; basal thickenings present, as shown in figure; ventral thickenings present; micropores so far as observed indicated in figure.**



Pygidium of ASPIDIOTUS PERNICIOSUS Comst.

This species is widely distributed over Indiana, having been reported from practically every county in the state. It is at present the most serious scale pest in the state and infests a variety of hosts, but principally apple, peach, plum and pear.

ASPIDIOTUS RAPAX Comstock.

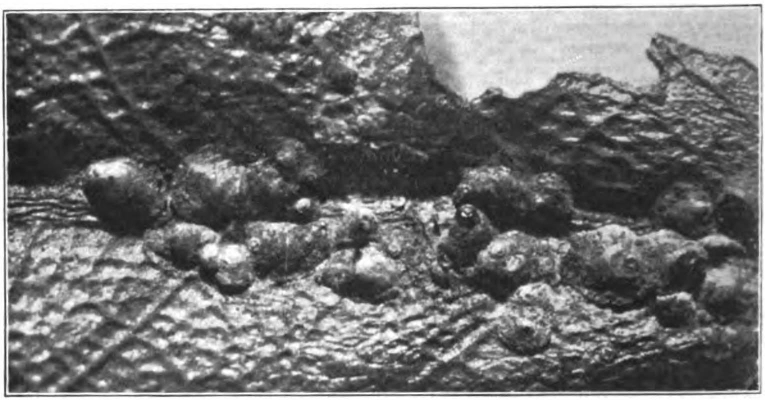
Aspidiotus rapax Comstock Rept. U. S. D. A. for 1880 (1881) p. 307

Aspidiotus rapax Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 276.

Aspidiotus rapax Comst. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 213.

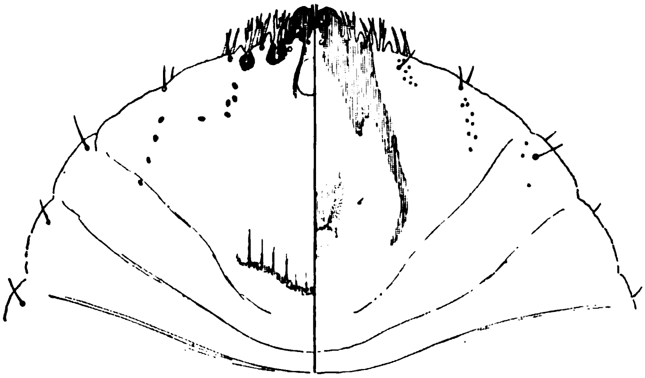
SCALE OF FEMALE: **Diameter about 1.5 mm.; circular, rather translucent, convex, sometimes whitish but usually gray, the color of the insect beneath occasionally showing through; exuviae to one side of the** center, covered by secretion, location indicated by a black or brown nipple; ventral scale white, usually entire.

SCALE OF MALE: Scale of the male similar to that of female, less convex; exuvia sublateral.



ASPIDIOTUS RAPAX Comst., enlarged. (After Douglass.)

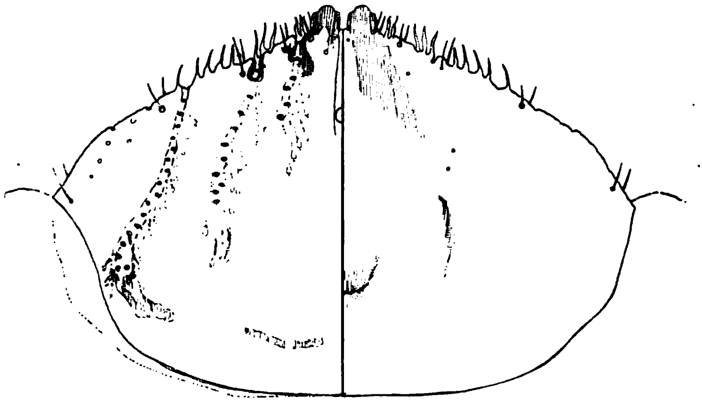
PYGIDIUM OF FEMALE: Small, broad, apex rounded; only the median lobes well developed, prominent, inner and outer margins converging towards the apices, the apex somewhat rounded, deeply and distinctly notched at each end, the inner notches nearer the apex than the outer, second and third lobes present as broad rather triangular plate-like projections of the pygidial margin, the second larger than the third; with two pairs of incisions, each with about equal chitinous thickenings on each margin; with two laterally serrate plates caudad of the first incision, the outer compound, a single plate caudad of the second lobe, entire or slightly serrate near apex, two plates caudad of the second incision, both serrate and the outer usually compound, these five in continuous series crowded close to median lobes,



Pygidium of ASPIDIOTUS RAPAX Comst.

with two usually simple plates laterad of the pointed third lobe; anal opening large, about circular, less than its own diameter from the apex of the pygidium; circumgenital gland openings wanting; dorsal gland openings about as shown in figure, about four in the inner row and one or two scattered cephalad and laterad of this row; micropores so far as observed indicated in figure; basal and ventral thickenings shown in figure.

This species has been found only in one Indianapolis greenhouse, where it has maintained itself for at least the last five years on "bay tree" (*Laurus nobilis*). It is sufficiently abundant at times to be considered an economic pest and has ruined many of the bay trees in this house.



Pygidium of ASPIDIOTUS ULMI John.

ASPIDIOTUS ULMI Johnson.

Aspidiotus ulmi Johnson, Bull. Ill. St. Lab. Nat. Hist. **4** (1896) p. 388.

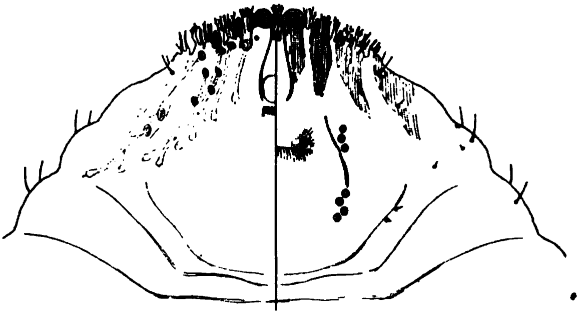
Aspidiotus ulmi Johns. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 280.

SCALE OF FEMALE: Diameter 1.5-2 mm.; nearly circular, dirty white to tan in color; exuviae in fresh specimens bright orange yellow; ventral scale well developed, white.

SCALE OF MALE: Length about .7 mm.; more or less circular, resembling that of the female.

PYGIDIUM OF FEMALE: Size medium, broad, margin rounded; only median lobes well developed, broad and prominent, inner margins parallel or slightly diverging, outer margins nearly parallel to somewhat converging, apical margin distinctly notched on both sides where it joins the lateral margins, strongly produced caudally between the notches, inner angle of the second lobes more or less developed, third lobes wanting; apex of pygidium with two pairs of incisions bounded by chitinous thickenings, the inner thickening on each side relatively very large and distinctly club-shaped, the outer one of each first incision very much smaller than the inner, thickenings of the second incision about equal in size and in some cases apparently united; with what appears to be a broad apically notched plate between the median lobes, this often not visible, with two simple or furcate spine-like plates caudad of first incision, with three, the second and third much larger, between the rudiments of the second and third lobes and with three to five, simple or once branched, laterad of second incision; anal opening oval, about four to five times its length from the apex of the pygidium; circumgenital gland openings not observed in any of specimens examined; dorsal gland openings small, in three distinct rows, the first of 3-5, second row of 8-11, third row about 12-17, but variable; basal thickenings, ventral thickenings and micropores, so far as observed, shown in figure.

Our only record for this species is Elkhart, Aug. 20, 1914, on American elm (*Ulmus americana*), at which time only a few specimens were found.



Pygidium of ASPIDIOTUS CYANOPHYLLI Sign.

ASPIDIOTUS CYANOPHYLLI Signoret.

Aspidiotus cyanophylli Signoret, Ann. Soc. Ent. Fr. Ser. 4, **IX** (1869) p. 119.

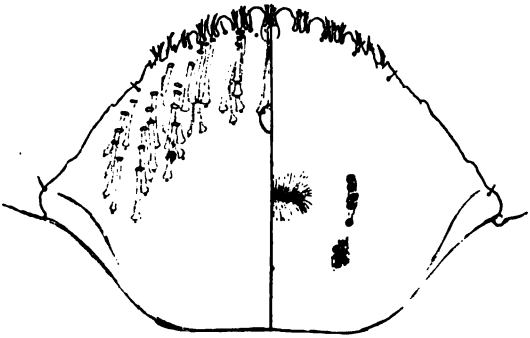
Aspidiotus cyanophylli Sign. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 255.

SCALE OF FEMALE: Diameter about 1-2 mm.; normally circular but varying to ovate or elongate ovate, very thin, flat, more or less transparent, pale brownish yellow; exuviae central, bright yellow but covered by a light-colored secretion; ventral scale poorly developed.

SCALE OF MALE: Similar to that of female, usually more elongate; exuvia subcentral, dull yellow in color.

PYGIDIUM OF FEMALE: Rather small, apex rounded; with three pairs of distinct lobes, the median large, broad and prominent, second and third distinct but much smaller, more slender and less prominent, median lobes more or less distinctly notched on both inner and outer margins near the apex, second lobe indistinctly notched on outer side beyond middle; with slight oval thickenings cephalad of outer margin of median lobes and inner margin of second lobes, almost continuous with thickened margin of a dorsal gland, almost giving the appearance of an incision with thickened edges; with a pair of plates between the median lobes, apically furcate, a pair between the median and second lobes, apically branched, with three between the second and third lobes, apically and laterally branched and with three to apparently five large compound plates laterad of the third lobes; anal opening rather large, approximately circular, less than twice its own diameter from the apex of the pygidium; circumgenital gland openings in four groups, anterior laterals 4, posterior laterals 3-5; dorsal gland openings approximately as shown in figure; ventral thickenings as shown in figure.

We have this species from two greenhouses in the state, located at Crawfordsville and Indianapolis, although it probably occurs elsewhere. The hosts were palms (*Phoenix roebelenii* and *Kentia* [*Howea*] *belmoreana*), and neither infestation was serious.



Pygidium of ASPIDIOTUS BRITANNICUS Newst.

ASPIDIOTUS BRITANNICUS Newstead.

Aspidiotus britannicus Newst. Ent. Month. Mag. 34 (1898) p. 279.

Aspidiotus britannicus Newst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. 88 (1903) p. 253.

SCALE OF FEMALE: Typically circular, or approximately so; diameter 1.75-2 mm.; rather thin, moderately convex; dusky ochreous with a broad smoky brown central zone; exuviae central or subcentral, orange yellow; ventral scale thin, evident only beneath the body of the insect, attached firmly to the leaf. (Newstead.)

SCALE OF MALE: More or less circular, diameter 1 mm., bright pale fulvous; exuvia central, bright ochreous. (Newstead.)

PYGIDIUM OF FEMALE: Large, margin rounded; with three pairs of large, broad, well developed lobes, the median a little larger than the second, both pairs distinctly and deeply notched on each margin, apices rounded, third pair a little smaller than second, indistinctly notched on outer and sometimes faintly on inner side; incisions with thickened edges wanting, apparently with indistinct incisions with faintly chitinized thickened edges between the second and third lobes; with two apically branched plates between the median lobes, two between the first and second lobes, three between the second and third lobes, branched both at apex and on lateral margins, with three large compound branched plates laterad of third lobes, and some indistinct serrations and teeth beyond these plates; anal opening nearer to apex than to base of the pygidium; circumgenital gland openings in four to five groups, the median usually wanting, arranged as follows in specimens examined: median 0-1, anterior laterals 5-8, posterior laterals 4-5; micropores so far as observed indicated in figure.

A. britannicus has been found once, May 18, 1915, in import inspection on "bay trees" (*Laurus nobilis*) imported from Ghent, Belgium, and a second time in an Indianapolis greenhouse where it was abundant and apparently firmly established on "bay trees," but was so highly parasitized that it was difficult to find suitable specimens for study.

ASPIDIOTUS HEDERAE (Vallot).

Chermes hederae Vall. Mem. Acad. Dijon (1829) p. 30.

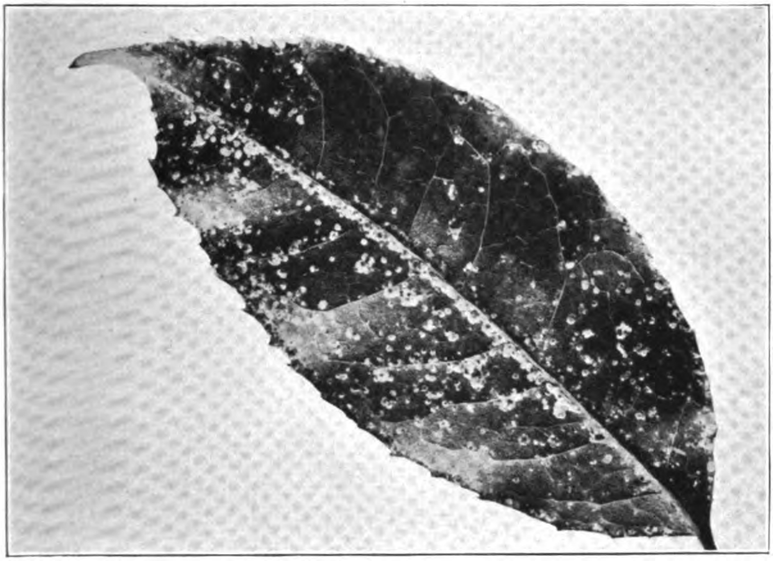
Aspidiotus hederae (Vall.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 260.

Aspidiotus hederae (Vall.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 203.

SCALE OF FEMALE: Diameter 1-2 mm.; approximately circular, varying to ovate, often irregular, flat or slightly convex; color very dull pale yellow, often whitish in well protected specimens; thin, somewhat transparent; exuviae central, yellow, covered in newly molted adult females but usually bare in older individuals.

SCALE OF MALE: Form variable, usually ovate; white; exuvia approximately central, usually naked and some shade of orange yellow.

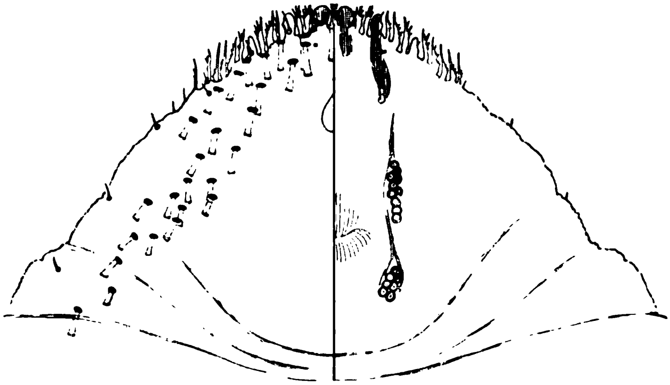
PYGIDIUM OF FEMALE: Broadly rounded, small; with three pairs of well developed lobes, the median the largest, the second pair somewhat smaller, the third small and slender, the median notched on both inner and outer sides, the inner notch nearer to the apex, second lobes indistinctly notched on the outer sides, as are also the third which are almost pointed at tip; no incisions or chitinous thickenings present; with two plates between the median lobes, two between the median and second lobes, all these apically branched, with three between the second and third lobes, with four to six laterad of third lobes, all these both apically and laterally branched; anal opening circular, about three times its diameter from the apex of the pygi-



ASPIDIOTUS HEDERAE (Vallot), natural size.

dium; circumgenital gland openings in four groups, anterior laterals 7-10, posterior laterals 5-10; marginal gland openings rather large, giving the margin a rather crenulated appearance and arranged as follows: one between the median lobes, one between the median and second lobes, two between the second and third lobes, the inner one ento-caudad to the outer two beyond the third lobes; dorsal pores arranged in three or four indistinct rows; micropores so far as observed indicated in figure.

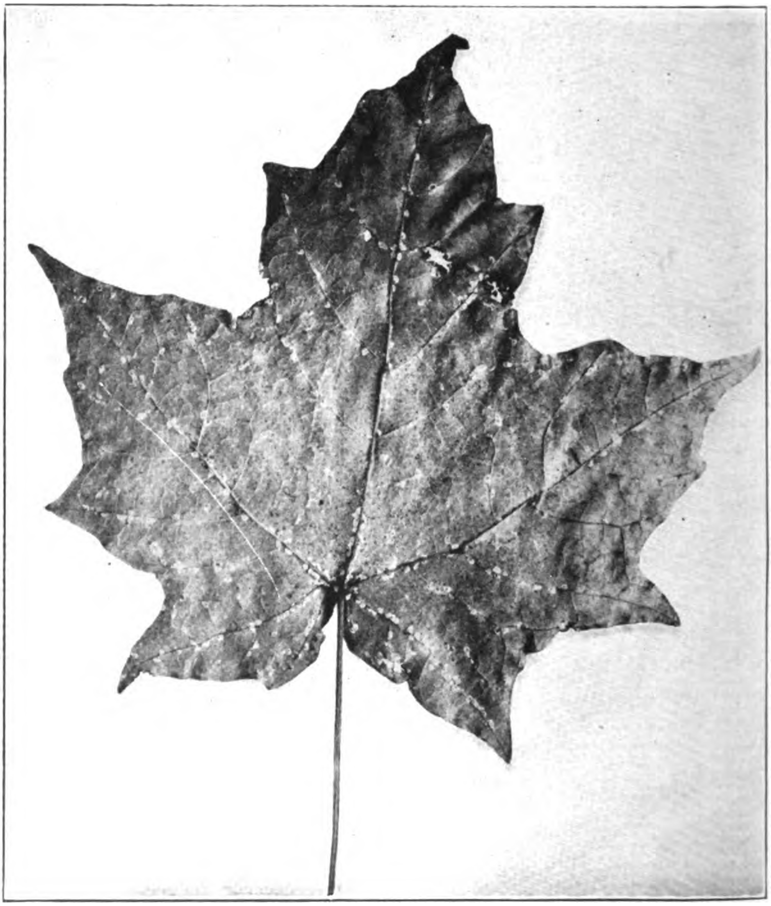
We have found this species in a number of greenhouses in the larger cities of the state. The hosts so far as observed in Indiana are undetermined palms, *Pandanus*, English ivy, Vinca, Jasmine, *Cycas revoluta*.



Pygidium of ASPIDIOTUS HEDERAE (Vall.).

ASPIDIOTUS COMSTOCKI Johnson.

Aspidiotus comstocki Johns. Ent. News **7** (1896) p. 151.
Aspidiotus comstocki Johns. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 254.
Aspidiotus comstocki Johns. Morrison and Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 75.

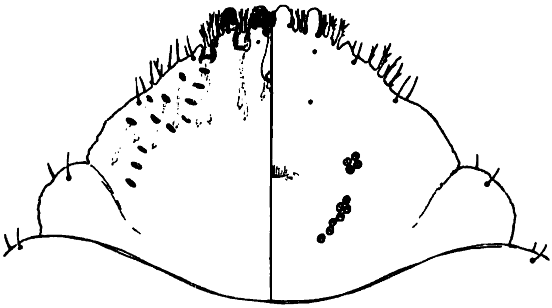


ASPIDIOTUS COMSTOCKI Johns. **Natural size on maple leaf.**

SCALE OF FEMALE: Extremely variable in shape, tending to a semi-oval form, but irregular when resting alongside a leaf vein; length about 1.5-2 mm.; width about 1 mm.; rather flat, thin, semi-transparent, whitish or slightly cream, portion covering the subcentral exuviae very light yellowish brown.

SCALE OF MALE: Oval, length about 1 mm., width about .5 mm.; usually grayish white, semitransparent; exuvia submarginal.

PYGIDIUM OF FEMALE: Rather small; with two large well developed pairs of lobes, equal in size, or the median a little stouter, the third lobes present as a tubercle, second pair of lobes typically as long or longer than median, sometimes a little shorter, median lobes notched on both inner and outer margins about the middle; with two pairs of incisions with thickened edges, and with a chitinous thickening on the inner margin of each median lobe; with two plates, apically branched, between the median lobes, with two apically branched, and about as long as the lobes, between each median and second lobe, with three plates both apically and laterally branched between the second and third lobes, and about four branched or simple plates laterad of third lobes; anal opening circular, much nearer apex than base of pygidium; circumgenital gland openings in four groups, anterior laterals 5-6, posterior laterals 3-5; dorsal gland openings in three rows first of one, second of about 5-6, third row of 4-6, and usually two scattered openings beyond the third row; micropores so far as observed shown in figure.



Pygidium of ASPIDIOTUS COMSTOCKI Johns.

We have a number of records indicating that this species is distributed over the whole state. In all cases where the host has been positively determined it has been hard or sugar maple (*Acer saccharum*).

ASPIDIOTUS LATANIAE Signoret.

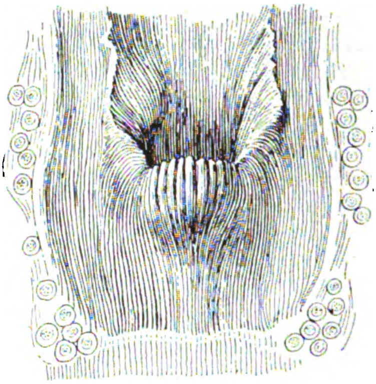
Aspidiotus lataniae Sign. Ann. Soc. Ent. de Fr. Ser. 4, Vol. **IX** (1869) p. 124.

Aspidiotus lataniae Sign. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 266.

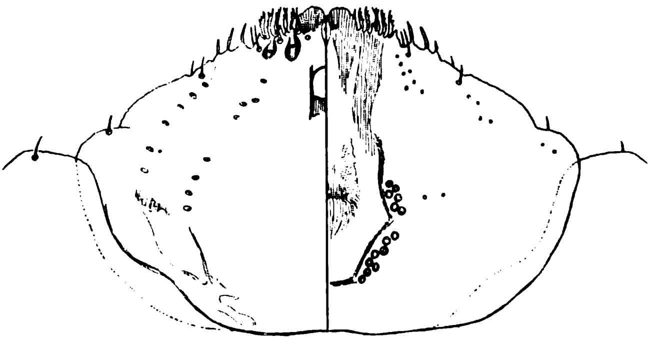
SCALE OF FEMALE: Diameter about 1.5-2 mm.; approximately circular, but somewhat irregular when clustered, strongly convex, rather dense, except margins which are semitransparent, central portion pale brown, rest dirty white; exuviae central or subcentral, large, covered by a light secretion, pale brown.

SCALE OF MALE: Similar to that of female in color, smaller and elongated.

PYGIDIUM OF FEMALE: Rather small, margin rounded, apex almost truncate, with lobes and plates projecting; with only the median lobes well developed, large, prominent, broad, the inner margins nearly straight and strongly converging toward the apex, apical and outer margins rounded into each other, the outer deeply notched beyond the middle, the apical faintly notched at the apex of the lobe, second and third lobes present only as small spine-like protuberances; chitinous incisions with thickened edges present, only these four pairs of thickenings present, the thickenings about equal in length; plates rather large, conspicuously furcate and closely crowded towards the median lobes, with two small plates between median lobes, two caudad of first incision, three caudad of second lobe and second incision, all these in continuous series, about two or three unbranched spine-like plates laterad of third lobe; anal opening large, oval, a little more than its own length from the apex of the pygidium; circumgenital gland openings in four groups, as follows in specimens examined: anterior laterals 8-10, posterior



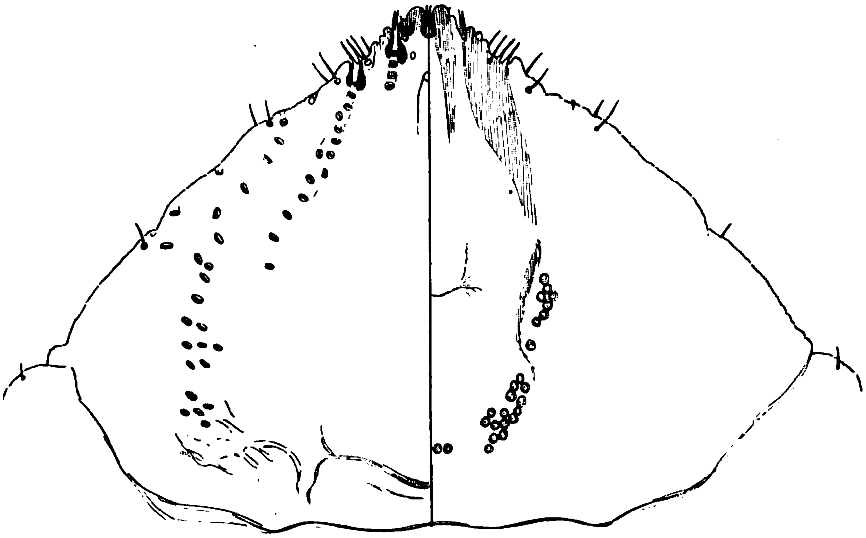
ASPIDIOTUS LATANIAE Sign. Genital opening much enlarged.



Pygidium of ASPIDIOTUS LATANIAE Sign.

laterals 6-8; dorsal gland openings small, in two rows, the inner in two indistinct groups of about 3-4 each, the outer in a single row of about 6-8. this variable; basal thickenings as shown in figure; ventral thickenings as shown in figure; micropores so far as observed, shown in figure.

This species has been found once, at Evansville, June 22, 1914, on a palm (*Kentia* sp.).



Pygidium of ASPIDIOTUS JUGLANS-REGIAE Comst.

ASPIDIOTUS JUGLANS-REGIAE Comstock.

Aspidiotus juglans-regiae Comst. Rept. U. S. D. A. for 1880 (1881) p. 300.

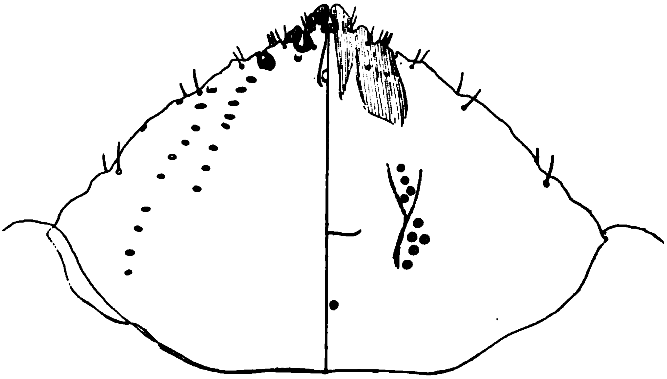
Aspidiotus juglans-regiae Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 265.

Aspidiotus juglans-regiae Comst. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 204.

SCALE OF FEMALE: Diameter about 3 mm.; circular, flat, pale grayish brown; exuviae subcentral, reddish brown, covered with secretion; ventral scale very thin, adhering to the bark.

SCALE OF MALE: Similar to that of female, smaller, about 1.25 mm. in diameter, more elongate.

PYGIDIUM OF FEMALE: Large, broad, triangular, the apex projecting; with three pairs of lobes, the third small and not strongly produced, median very large, prominent, somewhat converging, notched one to three times on outer margins, apices rounded, second lobes well developed, much less prominent than median, converging, inner margins nearly straight, narrowly rounded at apex, outer margins diagonal, coarsely crenulate; with incisions with thickened edges between the first and second and the second and third lobes, the inner thickenings larger and longer; with a chitinous thickening running cephalad along the inner margin of each median lobe and another inside of the outer margin of the median lobes; plates simple and very inconspicuous, two between the median lobes, two between each median and second lobe, three between each second and third lobe, none observed laterad of third lobes; anal opening small, about five times its diameter from the apex of the pygidium; circumgenital gland openings in five groups, as follows in specimens examined: median 2-4, anterior laterals 8-15, posterior laterals 7-9; dorsal gland openings in three rows, about as shown in figure; basal and ventral thickenings present, about as shown in figure; micropores so far as observed shown in figure.



Pygidium of ASPIDIOTUS FORBESI Johns.

This scale has been reported only from Marion county, but must occur elsewhere in the state. The hosts are hard maple (*Acer saccharum*), linden (*Tilia americana*), horse chestnut (*Aesculus hippocastanum*), and chestnut oak (*Quercus prinus*). It is sometimes of economic importance.

ASPIDIOTUS FORBESI Johnson.

Aspidiotus forbesi Johns. Ent. News 7 (1896) p. 151.
Aspidiotus forbesi Johns. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 259.
Aspidiotus forbesi Johns. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 201.

SCALE OF FEMALE: About 2 mm. in diameter; approximately circular, rather convex, somewhat delicate, color dirty gray; exuviae covered, orange, subcentral.

SCALE OF MALE: Oval, about 1 mm. long, darker than female scale; exuvia orange colored, situated anterior to the middle.

PYGIDIUM OF FEMALE: Medium, apex rounded, the tip projecting; with two pairs of lobes fairly well developed, the third pair entirely wanting, median lobes large, prominent, strongly projecting, inner margins converging towards the apex, this rounded, outer margins distinctly and sharply notched a little beyond the middle, sometimes with additional notches, second lobes much smaller than median but distinct, converging, apices rounded, outer margin notched; with chitinous thickenings as follows: on inner margin of median lobes, in the outer part of each median lobe, just outside of this a large, distinctly club-shaped thickening, then a smaller similar one running cephalad from the inner margin of the second lobes, these bounding an incision between median and second lobes and with chitinous thickenings bounding a second incision well laterad of second lobes; anal opening small, three to four times its diameter from the pygidial apex; circumgenital gland openings in four to five groups, median 0-3, anterior laterals 4-6, posterior laterals 3-4; dorsal gland openings arranged in three rows, about as shown in figure; micropores, so far as observed, shown in figure.

Our records show that this species has been reported only from Marion and Boone counties. According to Douglass the species is fairly common over the state on sour cherry. We have no authentic reports of this species as a serious pest.

ASPIDIOTUS ANCYLUS (Putnam).

Diaspis ancylus Putnam, Trans. Ia. Hort. Soc. **12** (1877) p. 321.

Aspidiotus ancylus (Putn.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 252.

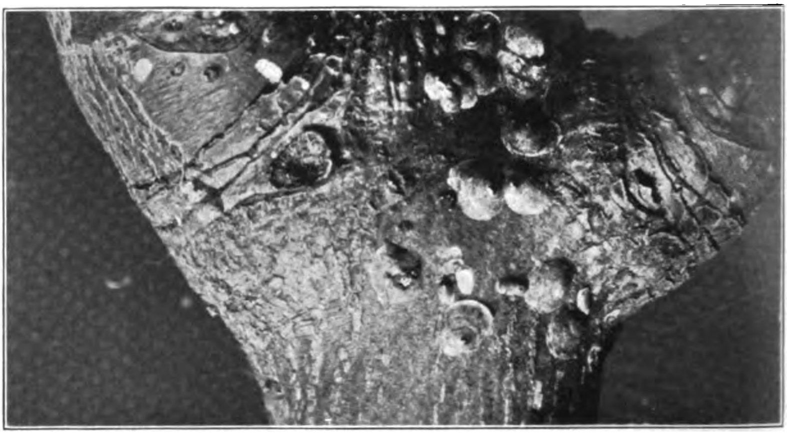
Aspidiotus ancylus (Putn.) Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 193.

SCALE OF FEMALE: Diameter 1-1.5 mm.; approximately circular, dark gray, sometimes almost black, margin of scale lighter; exuviae brick red, covered by a gray secretion; ventral scale white, very delicate.

SCALE OF MALE: Smaller than that of female and more elongate but similar in color.

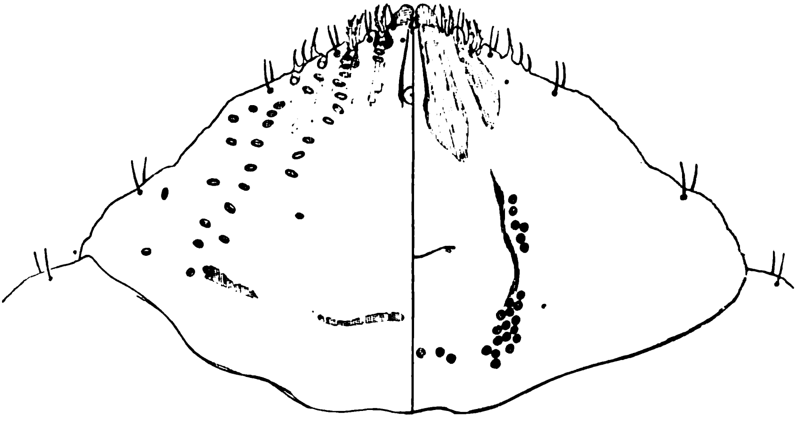
PYGIDIUM OF FEMALE: Rather large; median lobes very prominent, large, broad and strongly produced, apex rounded, outer margins always notched, inner margins typically entire, but often more or less distinctly notched near the apex, the inner margins more or less distinctly converging towards the apex, second lobes with the inner angles slightly developed, third lobes not developed; incisions present between the median and second and second and third lobes on each side; inner margins of each median lobe with a chitinous thickening near the base, margins of incisions with thickenings;

with a pair of small apically toothed plates between median lobes, with two laterally toothed plates between median and second lobes, with two similar ones between the traces of second and third lobes, and about three beyond the rudiments of the third lobe, these often broken; anal opening quite close to the apex of the pygidium, oval; circumgenital gland openings in four or five groups, as follows in specimens examined: median 0-5, anterior laterals 8-17, posterior laterals 5-8; dorsal gland openings somewhat variable, in three rows, with a few scattered ones beyond the third row; basal thickenings and ventral thickenings as shown in figure.



ASPIDIOTUS ANCYLUS (Putn.). much enlarged. (After Douglass.)

Our records show that this species is scattered over the whole state, and at times it is unquestionably responsible for the serious injury and death of some maples. According to Douglass this is



Pygidium of ASPIDIOTUS ANCYLUS (Putn.).

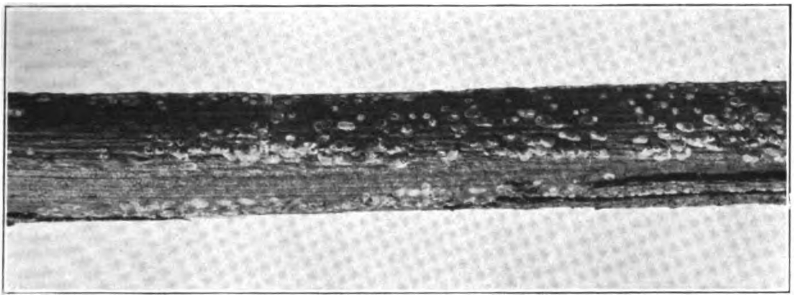
an important pest of both fruit and shade trees but the hosts on which it has been found in Indiana are hard and soft maple (*Acer saccharum* and *saccharinum*), currant, gooseberry and hickory (*Hicoria sp.*).

ASPIDIOTUS UVAE Comstock.

Aspidiotus uvae Comst. Rept. U. S. D. A. for 1880 (1881) p. 309.

Aspidiotus uvae Comst. Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 280.

Aspidiotus uvae Comst. Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 213.



ASPIDIOTUS UVAE Comst., natural size. (After Douglass.)

SCALE OF FEMALE: Yellowish brown, slightly lighter than the bark of the vine; diameter 1.1-1.7 mm.; circular and comparatively flat; exuviae bright yellow, subcentral.

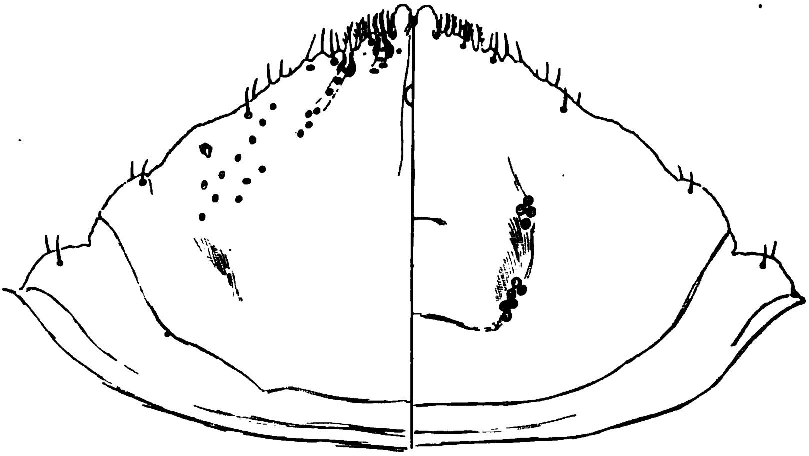
SCALE OF MALE: Elongate, length 0.9-1.0 mm.; width 0.5 mm.; exuvia to one side, slightly darker and more convex than female scale.

PYGIDIUM OF FEMALE: Anal plate 0.4 mm. broad at base by 0.23 mm. long; median lobes prominent, more or less parallel, slightly diverging at tip, notched on each margin, with inner notch fairly prominent and slightly elevated, lateral lobes wanting or rudimentary as is the case with *ancylus*; two distinct lateral incisions present; chitinous edges of first incision conspicuous, inner the larger, pear-shaped, chitinous edges of second incision much smaller; plates minute, obscure; spines on dorsal surface strongly developed, one on median lobe, one cephalad of each incision and one half-way to the penultimate segment, ventral spines smaller and laterad of dorsal spines; anal opening small, circular, about two and one-half lobes length from tip of median lobes; circumgenital gland openings, median 0-4, anterior laterals 4-9, posterior laterals 3-7; dorsal gland openings present in three rows, first consisting of 2 at first incision, second of 8 at second incision, third of 5-8 caudad

of fourth spine; median and lateral basal thickenings prominent; apical ventral chitinization strongly developed, brown; ventral longitudinal ridges fairly distinct.

This description is taken from that of Sasscer in U. S. D. A. Bur. Ent. Bull. 97, Pt. VII (1912) p. 117.

This species has been reported to us from Marion, Jackson, Dearborn, Knox and Harrison counties and according to Zimmer has been found at Lafayette. It is of decided economic importance on grape wherever it has been found, but appears to be easily controlled. We have also found what appears to be this species on sycamore (*Platanus occidentalis*) at Indianapolis.



Pygidium of ASPIDIOTUS UVAE Comst.

Genus CHRYSOMPHALUS Ashmead.

SCALE OF FEMALE: Similar to *Aspidiotus.*

SCALE OF MALE: Similar to *Aspidiotus.*

BODY OF FEMALE: Similar to *Aspidiotus*, but pygidium retracted into the body and not projecting in *C. aurantii*: color orange or yellow.

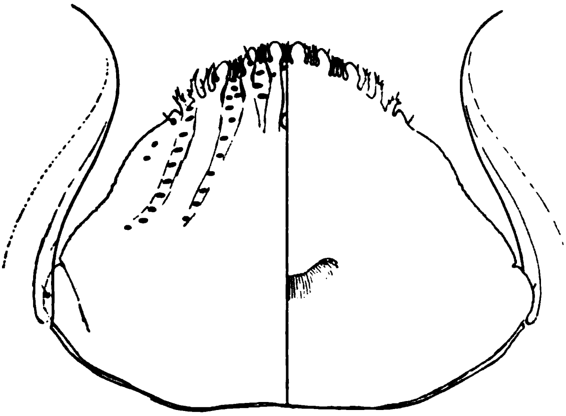
PYGIDIUM OF FEMALE: Similar to *Aspidiotus* except that the chitinous thickenings running anteriorly from the margin of the pygidium are much more elongate and more slender, and in one species are partly arranged in threes instead of in pairs.

KEY TO SPECIES.

A. Circumgenital gland openings absent .... *aurantii*

AA. Circumgenital gland openings present in adult female.

- B. Plates between the lobes simple or once branched, small and short; second and third incisions with three chitinous thickenings; circumgenital gland openings in five groups; size very large. *obscurus*
- BB. Plates strongly branched or serrate; second and third incisions with two chitinous thickenings each; circumgenital gland openings in four groups; size smaller.
  - C. The two outer groups of dorsal gland openings few in number and each arranged in a single row; marginal plates beyond the third lobes at most with their margins strongly serrate. . *dictyospermi*
  - CC. The two outer rows of dorsal gland openings numerous and each arranged in a double row—marginal plates beyond the third lobes strongly pectinate along their margins .... *aonidum*



Pygidium of CHRYSOMPHALUS AURANTII (Mask.).

CHRYSOMPHALUS AURANTII (Maskell).

Aspidiotus aurantii Mask., Trans. N. Z. Inst. **11** (1878) p. 199.

Chrysomphalus aurantii (Mask.) Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 287.

Chrysomphalus aurantii (Mask.) Morrison and Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 76.

SCALE OF FEMALE: Diameter about 2 mm.; circular, translucent, light gray in color, showing the insect beneath, somewhat convex; exuviae central, nipple-like.

SCALE OF MALE: Similar to that of female, but somewhat smaller, about .5 mm. in diameter; exuvia lighter in color.

PYGIDIUM OF FEMALE: Small, parabolic, the whole pygidium sunk into a depression in the caudal end of the almost circular body of the female; with three pairs of well developed lobes, the median notched on both inner and outer margins, the mesal notch nearer the apex, second and third pairs smaller and less prominent, notched and sometimes crenulate on outer margin, sometimes also notched on inner margin; chitinous thickenings slender, not club-shaped, not very long, a small one running cephalad from the inner margin of each median lobe, a longer pair, one from the outer margin of the median lobes, the other from the inner margin of the second lobes, a very small one from the outer margin of the second lobes and another pair the outer one smaller, from the inner and outer margins of the third lobes; with strongly branched plates as follows: two between the median lobes, two between the median and second lobes, three between second and third lobes, all about as prominent as the lobes, three large strongly branched compound plates laterad of third lobes; anal opening nearly circular, about five times its diameter from the median lobes; circumgenital gland openings absent; dorsal gland openings arranged in three rows, first cephalad of and between median and second lobes, of 2-3, second of about 14 running cephalad from between second and third lobes, third, of 6-8, running cephalad from just outside of the third lobes, 1-2 outside of the third row; micropores so far as observed indicated in figure.

This species has been found only once in Indiana so far as we know. This was at an Indianapolis greenhouse on twigs and leaf-petioles of an orange tree.

CHRYSOMPHALUS OBSCURUS (Comstock).

Aspidiotus obscurus Comstock, Rept. U. S. D. A. for 1880 (1881) p. 303.

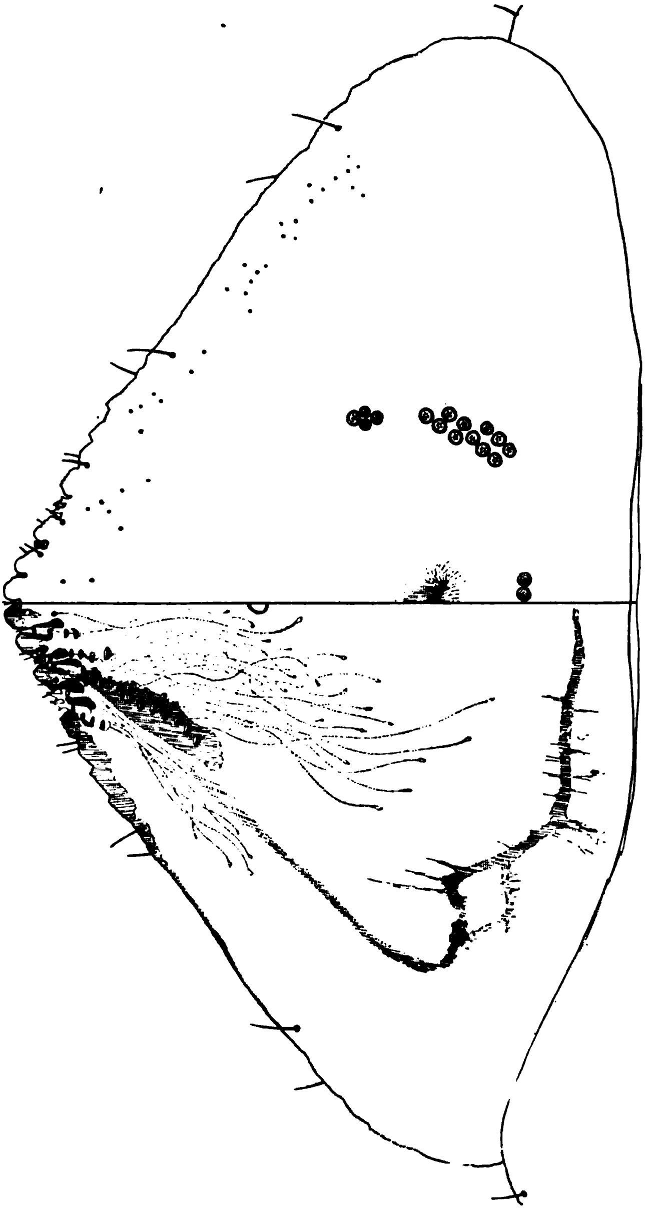
Chrysomphalus obscurus (Comst.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 291.

Chrysomphalus obscurus (Comst.), Morrison & Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 77.

SCALE OF FEMALE: Diameter about 3 mm.; approximately circular, only slightly convex, very dark gray, almost blackish in old specimens, closely resembling the bark on which it rests; exuviae only subcentral, nipple-like, with a white ring on a gray secretion, exuviae themselves shining black.

SCALE OF MALE: Similar to the female in color, oval in shape.

PYGIDIUM OF FEMALE: Large, approximately triangular, margin constricted at base, heavily chitinized; with three pairs of well developed lobes, the median the most prominent, all about equal in size but not alike in shape, fourth lobes present as a broad rounded projection of the pygidial margin, median lobes rather close together, broad, shape variable but usually with the inner apical angles more sharply rounded than the outer, which are



Pygidium of CHRYSOMPHALUS OBSCURUS (Comst.).

broadly rounded off and more or less distinctly notched, inner angle of large second and third lobes much more prominent than outer, the diagonal apical margins of the lobes more or less distinctly serrate, rudimentary fourth lobes also serrate; without incisions; margin of pygidium laterad of fourth lobes distinctly notched; with elongate club-shaped chitinous thickenings running cephalad from the pygidial margins as follows: one from the outer margin of each median lobe, one from both the inner and outer margins of each second lobe, one between second and third lobes, one from both the inner and outer margins of each third lobe, one from half way between third and fourth lobes and the last from the inner margin of the fourth lobe, these are grouped as follows: 2, 3, 3, the first and fourth are the longest and the sixth is the stoutest; plates small, inconspicuous, grouped as follows: one between the median lobes, one between each median and second lobe, two between the second and third lobes, two, relatively broad, stout, bifurcate plates between the third and fourth lobes, the inner tooth of each much longer; anal opening a very little nearer to the apex than to the base of the pygidium, slightly oval, small; circumgenital gland openings in five groups, as follows in the specimens examined: median 3-5, anterior laterals 11-14; posterior laterals 3-6; dorsal gland openings in four groups as follows: first of 3-4, second of 4, third in a more or less definite double row of 16-22, fourth group of 3-4; with heavy transverse basal thickenings as shown in figure; micropores numerous, some at least shown in figure; apical margin of pygidium thickened for much of its length.

We have this species from two places in the state, at New Harmony on *Hicoria pecan*, and in Marion county near Indianapolis on *Quercus coccinea*. It appeared to be doing considerable injury on the pecan trees.

CHRYSOMPHALUS DICTYOSPERMI (Morgan).

Aspidiotus dictyospermi Morgan, Ent. Month. Mag. **25** (1889) p. 352.

Chrysomphalus dictyospermi (Morgan), Fernald, Cat. Cocc. Mass. Hatch. Exp. Sta. Bull. **88** (1903) p. 289.

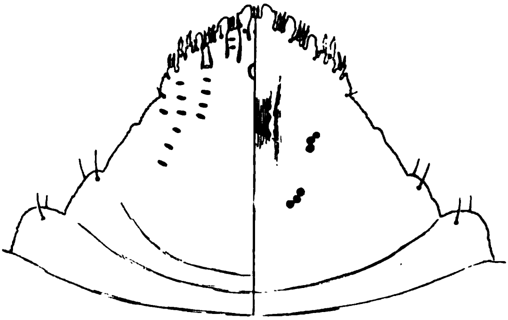
Chrysomphalus dictyospermi (Morg.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 219.

SCALE OF FEMALE: Diameter about 1.5 mm.; very light brown or grayish, flat, thin; exuviae central, nipple-like, covered by a secretion, nearly the same color as the rest of the scale; ventral scale thin, whitish, not well developed.

SCALE OF MALE: Similar to that of female, but more elongate and smaller.

PYGIDIUM OF FEMALE: Rather small, strongly projecting; with three pairs of well developed lobes, the outer margins of each distinctly and deeply notched; with long club-shaped chitinous thickenings running ceph-

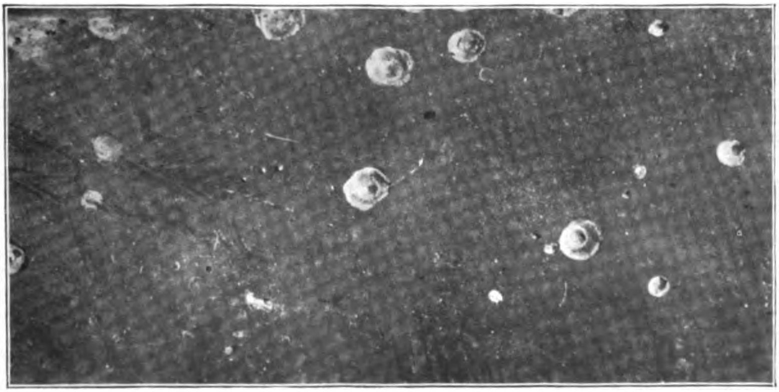
alad from the posterior margin of the pygidium as follows: one from both the inner and outer margin of each median lobe, one large one from the inner margin of the second lobe, one from laterad of the outer margin of the second lobe, and one from the inner margin of the third lobe, the largest of these being the second and third as located above; with fairly strongly



Pygidium of CHRYSOMPHALUS DICTYOSPERMI (Morg.).

branched plates, somewhat less prominent than the lobes, as follows: two between the median lobes, one between the first and second lobes, typically three, sometimes two between second and third lobes and three, basally broad, apically slender plates, with serrate margins, laterad of third lobes; anal opening about three times its diameter from the median lobes; circumgenital gland openings in four groups, anterior laterals 3-4, posterior laterals 2-3; dorsal gland openings in three rows, the first between median and second lobes, of 2, second between second and third lobes of 4-7, third outside of third lobes, of 4-6.

This species has been recorded from a number of greenhouses in the central and southern part of the state, the hosts being



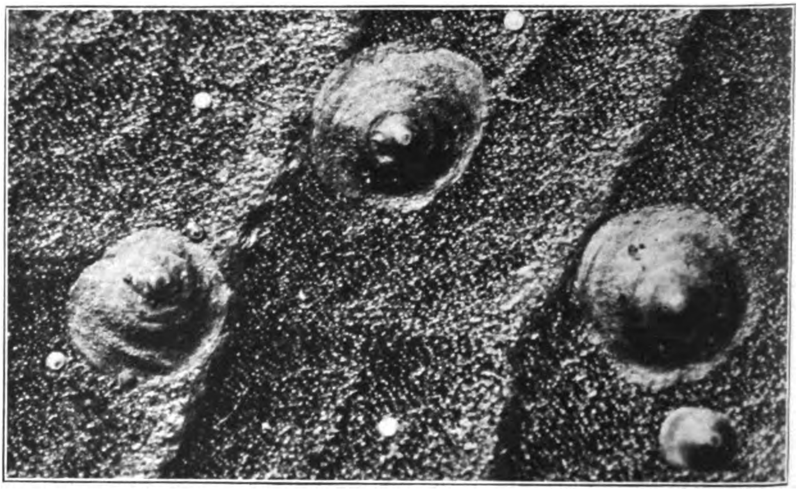
CHRYSOMPHALUS DICTYOSPERMI (Morg.). Females, enlarged.
(After Douglass.)

orchids, *Auracaria sp.*, Cape Jasmine and *Kentia belmoreana.* It does not appear to be a serious pest.

CHRYSOMPHALUS AONIDUM (Linnaeus).

Coccus aonidum Linn. Syst. Nat. Ed. **X** (1758) p. 455.
Chrysomphalus aonidum (Linn.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 286.
Chrysomphalus aonidum (Linn.), Douglass, Fourth Rpt. Ind. St. Ent. (1911) p. 213.

SCALE OF FEMALE: Diameter about 2 mm., but variable; circular, convex, opaque; exuviae central, reddish brown, covered by gray secretion surrounded by a reddish brown ring, the remainder of the scale dark brown to almost black, except more or less of the margin in many specimens, this ash gray; ventral scale hardly evident.

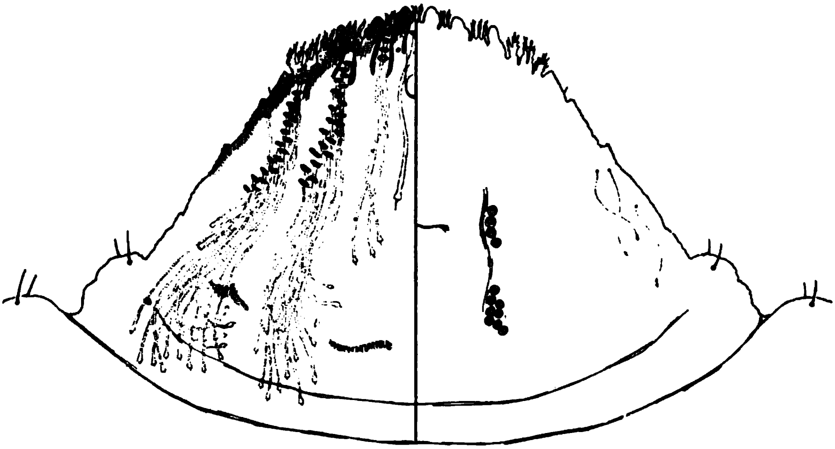


CHRYSOMPHALUS AONIDUM (Linn.), much enlarged. (After Douglass.)

SCALE OF MALE: Diameter .6-.8 mm. similar to that of female except for presence of long posterior gray flap.

PYGIDIUM OF FEMALE: Size medium, strongly projecting; median lobes well developed, strongly projecting from the pygidial margin, widely separated, inner margins sometimes faintly notched, converging, then rounded into each apex, outer margins deeply notched about the middle, second lobes closely resembling first pair in shape, slightly smaller and not so prominent, third lobes similar to others, smaller, less prominent, not distinctly notched on outer surface; with long and slender chitinous thickenings extending cephalad from the inner and outer margins of each median lobe,

one extending cephalad from the inner margin of the second lobe, another from a point beyond the outer margin of the second lobe, the middle three the longest; branched plates present as follows: two between the median lobes, two between the median and second lobes, three between second and third lobes, all these deeply and conspicuously fringed on the apical margin and a little longer than the lobes, outside of the third lobes, three large compound branched plates, the last the most conspicuously branched; rest of margin more or less conspicuously serrate; anal opening about three times its own diameter from the median lobes, oval; circumgenital gland openings in four groups, variable, as follows in specimens examined: anterior laterals 7-8, posterior laterals 4-5; dorsal gland openings in three groups, the first usually three in number, between the chitinous thickenings of the outer margin of the median lobe and the inner margins of the second lobes, the second group composed of a double row extending cephalad from between the next pair of thickenings and consisting of 22-25, the third row of about 20 or less, running cephalad from the three compound plates laterad of the third lobe; with transverse thickenings on each side cephalad of the circumgenital gland openings and near the base of the pygidium; the whole margin of the pygidium, except near the base, heavily chitinized; micropores so far as observed shown in figure.



Pygidium of CHRYSOMPHALUS AONIDUM (Linn.).

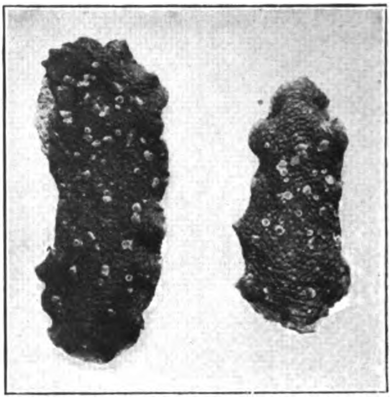
This species has been found in practically every greenhouse we have visited in the state, and it is without question, the most serious Diaspine scale pest with which florists must contend.

Genus PARLATORIA Targioni.

SCALE OF FEMALE: Circular to oval, whitish or grayish; exuviae marginal.

SCALE OF MALE: Small, elongate, slender, sides nearly parallel, light gray; exuvia terminal at cephalic end.

BODY OF FEMALE: Approximately circular, color variable, usually light purple; pygidium not produced beyond the body outline; with broad, more or less distinctly toothed plates on each margin of some of the abdominal segments anterior to the pygidium; pygidium with many large toothed plates along the whole margin.



PARLATORIA PROTEUS PERGANDEI. Natural size on orange peel.

PYGIDIUM OF FEMALE: With three pairs of well developed lobes, the fourth somewhat developed, projecting from the margin of the pygidium, all more or less distinctly notched, at least on the outer side, median distinctly separated; without incisions or chitinous thickenings; plates large, broad, deeply serrate apically, almost branched, with a pair between the median lobes and between each median and second lobe and three between the second and third lobes, and with a continuous fringe between the third lobes and the base of the pygidium; anal opening small, somewhat nearer apex than base of pygidium; circumgenital gland openings present, few in number, arranged in four groups; marginal gland openings present, one between median lobes, one between median and second, one between second and third, one just beyond third, one just before rudimentary fourth and two near base of pygidium; dorsal gland openings present, scattered, not arranged in distinct rows.

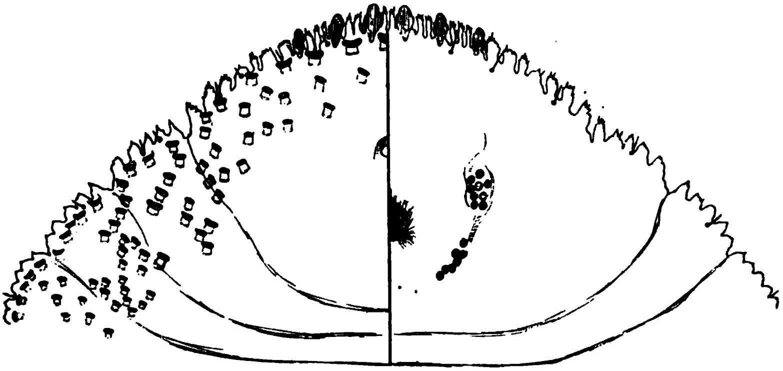
PARLATORIA PROTEUS (Curtis).

Aspidiotus proteus Curtis, Gardners' Chronicle (1843) p. 676.

Parlatoria proteus (Curt.), Fernald, Cat. Cocc. Mass. Hatch Exp. Sta. Bull. **88** (1903) p. 320.

Parlatoria proteus (Curt.), Palmer, Kas. Univ. Sci. Bull. **3** (1905) p. 137.

Parlatoria pergandei Comst., Morrison and Dietz, Sixth Rpt. Ind. St. Ent. (1913) p. 77.



Pygidium of PARLATORIA PROTEUS (Curtis) var. *pergandei* Comst.

SCALE OF FEMALE: Somewhat less than 2 mm. long; varying from nearly circular to elongate ovate, thin, semitransparent, not very convex, dull white or dirty gray in color; exuviae large, circular, marginal, pale yellow brown in color, semitransparent; ventral scale fairly well developed, usually remaining attached to the dorsal scale and at least partially enclosing the insect.

SCALE OF MALE: Length about 1 mm.; elongate, narrow, not carinated medially, but with the lateral margin prominent, light gray in color; exuvia light yellow.

PYGIDIUM OF FEMALE: Broadly rounded, small, not heavily chitinized; with three pairs of well developed lobes, sub-equal in length, all deeply notched on both inner and outer sides, the inner notch much nearer the apex than the outer, the fourth lobe present as a very slightly developed plate, with a very stout tooth just inside of the middle; no incisions or chitinous thickenings between the lobes; plates large, as long as the lobes, closely filling the space between them, fringed with long teeth on the distal margin only, with two between the median lobes, two between the median and each second lobe, three between each second and third lobe, all these relatively long and narrow, three between the third and the rudimentary fourth, three between the rudimentary fourth and the base of the pygidium, all these six relatively shorter and broader, the apical serrations of each plate usually longer and more prominent; anal opening small, circular, located about halfway between the base and apex of the pygidium; circumgenital gland openings in four groups, anterior laterals 5-9, often arranged in a nearly straight single line, posterior laterals 5-9, usually grouped in a cluster; with large marginal gland openings with semicircularly thickened margins as follows: one between the median lobes, one between the first and second, one between second and third, two between third and rudimentary fourth, two beyond the fourth lobe; dorsal gland openings variable, but usually about as shown in figure, the single gland behind each median lobe apparently the only constant one.

We have found this species in three greenhouses in the state, at Indianapolis, Lafayette and Evansville, in each case on orange or lemon trees.

We have followed the work of Miss Palmer, referred to above, in giving a name to this species. All of the specimens have the lobes developed as in typical *P. pergandei*.

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